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### ADDRESS OF THE PRESIDENT

#### HIGHER DEGREES IN THE PROFESSION OF SURGERY

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IN THESE latter days, and perhaps particularly in this new and progressive continent, there has arisen in considerable numbers a certain type of surgeon which we all recognize and deplore. He is the natural product of those discoveries and inventions—anesthesia, asepsis, fine tools, and well equipped small hospitals—which have rendered the practice of surgery, in its purely mechanical aspects, relatively safe. He is also the product of some of our national qualities, characteristic of all young and rapidly developing countries. He is progressive, venturesome, and self-confident, and such qualities are perhaps those which have placed the best of American surgery in its present proud position. But in the particular type to which I refer, venturesomeness becomes foolhardiness, and self-confidence is uncontrolled by knowledge. To such a man the sum of acquired knowledge is comprised in the popular theories of the year just past. Theory is counted as fact, and hypothesis as a thing proved. A decision to operate is based upon a medical catch word, or a rule of thumb. Technic becomes the be all and end all of surgery. Fingers replace brains, and handicraft outruns science. The result is that such a surgeon is apt to undertake operations which may be technically possible, but are scientifically unjustified. It is, our medical friends infer, an attitude of mind, which is the product of half-baked knowledge, which, in the last analysis, has in it more than a touch of carelessness, indeed, often towards the internist, a touch of impertinence. The medical man, interested and anxious, who finally decides

upon a surgical consultation, is often more in fear of the slipping mind than of the slipping hand.

While this type of surgeon is occasionally found, as we all know, on the staffs of even the largest of our hospitals, his special field lies in the small towns, and even in the country parts, and that field is an enormous one. And it has become obvious to intelligent and reflective surgeons that the most serious problem of the day is concerned with the provision of competent surgeons, not for the large metropolitan hospitals, which are naturally staffed by the best men, but for the small towns and rural districts, with their small local hospitals. Doctor Greenough called attention to this in his Inaugural Address at last year's Congress. It is extremely important, in view of the universal increase in the number and variety of surgical operations, popularized by the growing familiarity of the public with the idea, made relatively safe by asepsis and improved anesthesia, and rendered convenient by the rise of the small-town hospital all through the country, that there should be made available for this public a higher degree of surgical judgment and skill than has hitherto been the case. It is hardly necessary to say that these were in part the ideals of the Founders of the American College of Surgeons in 1913. But that there had grown up by that time, and that there still exists, a tendency on the part of imperfectly trained men to undertake major surgery, nobody will deny.

I submit that there is still a real need for the education of the surgically ambitious to a greater sense of personal responsibility, in fact of conscience, so that they will be unwilling to undertake the grave responsibilities of major surgery without adequate training. There is still much need of that adequate training on the part of many who wish to be recognized as surgeons. There is a need for the establishment of some sort of obligation, perhaps even a legal obligation, which would demand such adequate training. And there is also a definite need for the provision of greater facilities for the acquirement of that training. Moreover, the public should be enabled to recognize who is a responsible surgeon and who is not. That can be attained only by some degree or diploma, the holding of which would be a guarantee of such adequate training.

With these thoughts in mind, when I came to consider what should be the subject of this Presidential Address, it occurred to me that it might be interesting and perhaps useful to put before the members a short review of the conditions which, in various countries, have been laid down for the attainment of higher degrees in the profession of surgery.

We are all fairly well acquainted with the requirements of election to the Fellowship of the American College of Surgeons, which is practically the only certificate or diploma in America that can be acquired by one who may desire to practice surgery as a specialty. But we are, perhaps, less familiar with the details of the examinations leading to the Fellowship of the Royal College of Surgeons of England, of Edinburgh, of Australasia, or



of Canada; to the title of Chirurgien des Hôpitaux and of Agrégé, in France, and to the rank of Privat Dozent in Germany.

Let us take first England, including Scotland. What here constitutes the higher training in surgery, and what are the certificates of such training? Some of the larger universities offer a higher degree, usually called Master of Surgery; and I am told that to become a Master of Surgery at Cambridge, for instance, demands the passing of the stiffest examination in the world. But such degrees are purely academic, and candidates are few. When we think of the higher British surgery, we really consider only the Fellowship of the Royal College of Surgeons of England, of Edinburgh, or of Ireland.

To become a Fellow of the Royal College of Surgeons of England, a candidate has first to produce evidence that he has been engaged in the study, or the practice and study, of the profession for at least six years after graduation. The only other requirement is that he should pass the examinations, primary and final, set by the Board of Examiners of the College. That is recognized as an extremely arduous task. It demands of the average candidate special preparatory study of several months' duration, with usually the help of a coach or tutor, both for the primary examination in anatomy and physiology and for the final in surgery, surgical anatomy, cadaver operations, and surgical pathology. One who passes these examinations and becomes a Fellow of the College can be depended upon to possess a wide and sound knowledge of these subjects. But it is a curious fact that apprenticeship experience in a hospital is not categorically demanded, and, therefore, the candidate's experience in the performing of operations may be decidedly limited. Even if, as a matter of fact, the majority of the candidates have served for several years as house surgeons, the degree itself guarantees no particular ability in the conduct of operations. That, I think, is the chief defect in the English and Scotch admission to Fellowship, in so far as the F.R.C.S. degree suggests to the public the possession of skill as well as of knowledge.

Let us turn now to the requirements for election to the Fellowship of the American College of Surgeons.

The Board of Regents of the College at the beginning had to make their choice between following the example of the English College of Surgeons, with its notoriously stiff examination, and adopting some less rigid system, which would chiefly take into account a candidate's practical ability in surgery, without troubling much about theory; which, in particular, would not require of him a written or oral examination in either primary or final branches. They chose the latter plan. In view of the deplorable conditions existing in America at that time, respecting the prevalence of incompetent surgery, it seemed better to the Regents to try to elevate the standards of the general mass of surgeons than to establish by severe tests a *corps d'élite*. The majority of us will, I think, agree that at that period their decision in principle was wise. There was, in some degree, an emergency to meet.

The details of the plan of admission to Fellowship, practically unchanged

from the College's foundation, were well set forth by the late Director General, in his Inaugural Address of 1929. Doctor Martin began by describing the standards of examination "adopted and in use by the time-honored Colleges of Surgeons of England, Ireland and Edinburgh." "It was found," he said, "that almost without exception their requirements and tests were formulated before modern surgery came into existence. They are similar to those which are now exacted of internes and hospital aids to ascertain the candidate's knowledge of academic facts, instead of his practical ability to apply such knowledge towards the accomplishment of deeds." He went on to say, "After thorough and careful study of the whole problem there was no reason why we should begin by adapting obsolete plans to a twentieth-century program" (strange words!); and he then proceeded to describe the requirements for admission as Fellow of the American College of Surgeons.

"First: He must have graduated from a medical college approved by the College of Surgeons (or its equivalent); and he must have served at least one year as interne in a creditable hospital and two years as surgical assistant, or he shall give evidence of apprenticeship of equivalent value.

"Second: Five to eight years after graduation in medicine, devoted to special training and to practice, is normally the time requirement for eligibility to Fellowship, so the candidate may prove that he has the proper temperament, and is mentally and mechanically adapted to do surgery.

"Third: The moral and ethical fitness of the candidate as a physician and as a citizen shall be determined by reports of surgeons whose names are submitted by the candidate himself, and by such other reports and data as the Credentials Committee and the administration of the College may obtain.

"Fourth: The professional activity of the candidate shall be restricted to study, diagnosis and operative work in general surgery or in special fields of surgery. His specialization in surgery or one of its specialties must be not less than 80 per cent in communities of more than 50,000 inhabitants, and 50 per cent in smaller communities.

"Fifth: He shall make formal application for Fellowship, which will record full data regarding his educational opportunities, his medical training and post graduate work, and his literary efforts; and he shall give the names of not less than five personal references."

(The rest I shall summarize from Doctor Martin's statement, adding certain comments.)

At this point the candidate's application, together with the replies from his "references," are referred to the State or Provincial Committee of Credentials, which votes to accept, postpone, or reject the applicant. If accepted, he is then required to file complete case records of 50 major operations performed by himself, and brief abstracts of 50 major operations at which he has acted as assistant, or performed himself. These records are then examined by a Central Committee of surgeons in Chicago. This Central Committee, in the past seven years, has had to read carefully from 59,000 up to 67,300 of such case records each year. In 1922, there were 75,600.

In the year 1933, 656 sets of histories were received, and of that number 631 sets, or 63,100 individual histories, were examined in detail by the Committee on History Reviews. Of those reviewed 555 sets were accepted and 76 sets were not accepted. Those whose histories are not accepted have the privilege of later submitting additional histories. Seventeen surgeons of Chicago, drawn from the four leading medical Universities in Chicago, constituted in that year the Committee on History Reviews. This means that approximately 3,712 case records had to be examined by each member of the Committee. "If these records are lacking in any essential, which in the judgement of the Committee can be corrected, the candidate is notified of the fact and an opportunity is given him to supply the omission."

This amounts to a temporary ploughing of only 12 per cent (in 1934 only 9 per cent) and of these 12 per cent it is to be presumed that the majority were later passed, after they had been given an opportunity of correcting or adding to their submitted case records. In justice, however, it should be added that in the last six years the Year Book gives figures which show that of the applications on file in any one year, from 33 to 49 per cent were rejected or postponed by the State or Central Credentials Committees, presumably because the candidates' records did not satisfy the five preliminary requirements. These are not allowed to submit case records, at any rate for the time being. But one may conclude that nearly every applicant who is accepted for examination on the basis of one year as intern and two years' surgical apprenticeship, if his moral and ethical fitness is certified to by "references" submitted by the candidate himself, if a 50 to 80 per cent proportion of his practice is limited to surgery, and if he takes an oath not to split fees, can count upon his being admitted to Fellowship on the basis of his case records.

In the British Dominions we have the Royal Australasian College of Surgeons, founded nine years ago, and the Royal College of Physicians and Surgeons of Canada, founded four years ago. The latter is so young an institution, and its practice, as to examinations, still so much in the formative stage, that it is hardly worth while considering it at any length; but its standards so far are comparable with those of the Royal College of Surgeons of England. In the past three years only six candidates have presented themselves for the final examinations, and of these three have been ploughed.

The Royal College of Surgeons of Australasia, which, on a recent trip to Australia, I had the opportunity of investigating, was founded in 1926, and it is interesting to record that this was due in large measure to the visit to Australia, in 1924, of Dr. W. J. Mayo and the late Dr. Franklin Martin, who, at a meeting in Melbourne, outlined the ideals, aims and opportunities of the American College of Surgeons, and offered a Fellowship of the American College to some 25 leading surgeons of Australia and New Zealand. It was at first a voluntary association, but in 1930 it was incorporated and received from His Majesty King George V a royal charter.

The Australasian College, having clearly in their minds the two systems

of creating Fellows as established in England and in America gradually formulated their own system, which was designed to combine the advantages of both. Their fundamental principle was "to superimpose upon a sound training in the principles of surgery, entailed in the acquisition of a senior surgical degree or diploma, a period of apprenticeship to a senior surgeon in operative and clinical work."<sup>1</sup> Such requirements amounted in practice to demanding of a candidate that he pass the same sort of primary examination as obtains for the Fellowship of the Royal College of Surgeons of England; that is, a stiff examination in anatomy, physiology, and pathology; and of demanding over and above this a sufficiently long experience (five years postgraduate training in surgery as a minimum) in the actual practice of surgery under an approved senior surgeon. This they considered to be much more desirable than the submission of 50 or 100 case reports of operations actually done by the candidate, as in our American system. But they made a proviso that such case reports, if thought necessary, might be required in any particular instance. Credit was given for time spent as a Resident Medical Officer; for work in university departments, and in other countries; for research work; but emphasis was laid chiefly upon the desirability of an apprenticeship period to a senior surgeon. "The practice of attempting to qualify by performing a series of operations, unaided and unsupervised, was viewed with disapproval." Examining Boards were set up, one in Australia and one in New Zealand, called Boards of Censors, each seven in number, over which a Censor in Chief was established. The members of the Board of Censors were the leading surgeons in Australia and in New Zealand. Permission to appear before a Board of Censors as a candidate had first to be obtained from the Censor in Chief, by submission in writing of the candidate's qualifications.

"Full information concerning the candidates granted permission to appear before a Board of Censors is circulated to all members of the appropriate Board. Reports are obtained from surgeons with whom the candidate has worked; his contributions to surgical literature, if any, are studied; and all details of his training are verified. In short, before his interview with the Board, an endeavour is made to determine what manner of man he is. Then follows his appearance before the Board, which, at present, consists of a talk with the candidate extending over a space of 20 minutes upon practical problems in surgery. The expression 'at present' is used advisedly, because the Board has the power to vary the test in the light of its experience. It has found, however, that it is possible to conduct a very searching inquiry during the 20 minutes as to how far a candidate has profited by his training. The decision of the Board does not depend exclusively upon the answers given by the candidate in this space of time, for it also gives credit for the work he has done during the training period. Adequate time is allowed after each interview for a consultation among members of the Board upon the merits and demerits of each candidate, based partly upon their personal observation of him and partly upon the reports received concerning the work he has done.



"Candidates rejected by the Board must undergo a further period of training before permission is granted to reappear before it."

One notes that the stiff Final Examination of the Royal College of Surgeons of England is reduced to a short oral examination, and is, in fact, replaced by the long period of apprenticeship.

I confess that I was most favorably impressed with the Australasian system.

In Germany, so far as I know, there exists no particular examining body corresponding with the Royal College of Surgeons of England, or the American College of Surgeons, through which a young surgeon may obtain a higher degree or diploma. Medical education, both undergraduate and graduate, is ultimately controlled by the State; that is, by a Federal ministry, although naturally the various universities, all State-founded and State-supported, undertake the actual work of medical instruction, and act as examining bodies.

There are, however, two postgraduate university degrees open to the ambitious in many professions, including surgery—the habilitation and the Dozentur, or permission to teach. These, before last January, were essentially identical, and could be acquired in one and the same examination. Under the new law of this year these were separated, and habilitation became a title or degree standing on its own feet. The candidate who passed his habilitation examination might or might not proceed to the higher degree of Dozent, which was reserved to those who aimed at a teaching position in Universities and High Schools. Habilitation was a necessary stage towards the Dozentur. Habilitation, therefore, became a new academic degree, which was to be obtained only through independent scientific work, considerably in advance of the requirements for the ordinary graduation degree of Doctor, and the license to practice. To acquire the Dozentur, that is, to become a Privat Dozent, there was demanded in addition to the habilitation standards, definite proof of the candidate's teaching ability, and above all, of his qualifications in person and in character for the profession of teacher.

The requirements for the degree of habilitation are now as follows:

The candidate is not eligible for the examination before the third year after graduation. His title consists in the addition of the word "habilitiert" (abbreviated to habil.) to his University degree, as, for instance, "Dr.Med.habil." Application for the degree must be made to the appropriate Faculty. The details of his educational career and his publications are to be submitted. The actual habilitation examination consists in the presentation of a thesis, which must be published within the ensuing year. After acceptance of the thesis the Faculty summons the candidate to an open scientific discussion, in the presence of the University "Rektor," or Principal. This discussion, or examination, may be upon any part of the candidate's specialty. If accepted by the Faculty he is recommended to the State Ministry of Education, which, if it agrees, refers him back to the Faculty for the actual awarding of the degree.



It is, therefore, seen that, in Germany, there exists this higher degree of habilitation in surgery, which may guarantee to the public a certain amount of advanced knowledge. To me the requirements seem less exacting than those of either the English or the American Fellowship. They do not demand particular evidence of a knowledge either of the basic sciences or of practical surgical experience. But they do demand evidence of ability in research, clinical or experimental, and of an advanced clinical knowledge.

As to the degree of Privat Dozent, only those are eligible who can be accepted as teachers. The Faculty invites the applicant to a public test of his teaching ability. On three different days within one week he is asked to give a public lecture of three hours' total duration upon a subject or subjects in his specialty. The subject of his lecture is chosen by the Faculty out of three submitted by the applicant. The "Rektor" of the University, the teaching members, and also students are invited. After being accepted the candidate still has to go through a period of service in a Community Camp, and in a "Dozentenakademie."

In so far as university teaching, skilled hospital work, and the advancement of research are concerned, the needs of the higher surgery have always been well looked after by the class of Privat Dozenten, but these can fill as practising surgeons only a limited portion of the needs of the general population, outside the university clinics and the larger non-teaching municipal hospitals, for capable and advanced surgery. This second large field of necessary work, in towns and villages, which is so much in my mind, for which the Royal College of Surgeons of England, and the American College of Surgeons does so much, is taken care of presumably by those who have gained the habilitation degree, and by men who have been Voluntaer-Assistenten in the larger clinics, but have failed to secure hospital appointments, still less teaching appointments, or the higher positions in non-teaching municipal hospitals. If a surgically ambitious man is thus forced to settle in a comparatively small community, and is, nevertheless, well trained in practical surgery, he can point at best to such qualifications as those just mentioned. I doubt if in the eyes of the public the habilitation degree carries as much weight as the F.R.C.S., or the F.A.C.S.

In France a somewhat similar condition of affairs obtains, but without, so far as I know, any degree corresponding to the German habilitation. Here the man, ambitious to become a surgeon, has open to him, first, the Internat, which means in brief that before graduation, during his clinical years as a student, through a stiff competitive examination, he may secure an appointment as intern in any large hospital, in the service of a senior surgeon. In this position he undoubtedly acquires, during his term of five years of service, a large experience in general surgery, as well as in the French method of teaching. He often does not take the final examination for his degree in the university, and his license to practise, until the end of his internship. After this, if he is lucky, he may be allowed to serve in some large teaching hospital, as a sort of voluntary assistant, meanwhile devoting himself to study and to

research in preparation for the higher degrees of Chirurgien des Hôpitaux, and Agrégé. These are both decidedly difficult competitions, there being many candidates for relatively few positions. The examination demands a thesis, and the delivery of one or more clinical lectures before a jury. The Agrégé corresponds more or less with the Privat Dozent in Germany. From the class of the Agrégés the higher positions of chief surgeon and professor are recruited, and in this way the upper levels of surgical achievement in France are adequately filled. As in Germany, also, the surgical work in the larger non-teaching municipal hospitals throughout the country is taken care of by well-trained men, who have not tried, or have failed to secure positions in the metropolitan clinics. But again, as in Germany, the needs of the country and the smaller towns for competent surgery have to be met by "interns" who may have failed in their Agrégé examinations, and these cannot write after their names what might correspond to F.R.C.S., or F.A.C.S., as a legitimate indication to the public that they have had an adequate training in their specialty, for there exists no examining body to give them such special diplomas. They endeavor to secure the advantage of this legitimate form of advertising by putting in brackets after their names, say on their letter-heads, "Ancien interne" of such and such a hospital clinic. Yet, as a matter of fact, an "ancien interne" will often have acquired a clinical experience and an operative ability decidedly superior to that of our Fellows of the English or American Colleges.

It is inevitable after such a review that one should go on to compare these various systems. France and Germany may as well be left out, as their point of view is so different. There remain the other three. What, in résumé, are the chief differences between these three systems? Let us set them forth briefly under headings.

(1) *Character.* Moral and Ethical Fitness.

In England, no particular attempt is made to ascertain this. Apparently one assumes it. And that assumption seems to be justified. In America and in Australasia, inquiries are addressed to the five gentlemen whose names have been given by the candidate as his "references," and to the surgeons under whom he has served his apprenticeship.

(2) *Basic Sciences.* Anatomy, Physiology, and Biochemistry.

In England and Australasia, the candidate must pass a stiff examination in these subjects, an examination which is counted harder than the ordinary one for undergraduate students. Many fail. The candidate may go up for this examination during his undergraduate course, after passing the Primary of his medical school. In America, no such examination is required. It is apparently assumed that the knowledge of these subjects acquired during his undergraduate course, and his postgraduate clinical training, remains with him. (A dubious assumption!).

(3) *Surgery and Surgical Pathology.*

In England there is a written examination, followed by an oral on clinical

cases, and on pathologic specimens; also an examination in operative surgery on the dead body. Usually from 40 to 60 per cent are ploughed.

In Australasia, the examination is only an oral one of 20 minutes before a Board of Censors, composed of seven of the leading surgeons. Chief reliance is placed on the evidence of a long apprenticeship in a hospital under a recognized senior surgeon.

In America, the candidate is not seen by the examiners. His examination consists of his 100 case reports, which are assumed to show forth sufficiently his knowledge of surgery. Knowledge of surgical pathology remains unexplored.

(4) *Postgraduate Period of Apprenticeship Necessary for Eligibility.*

In England, six years, but no period of surgical apprenticeship is specifically demanded. In practise, the examination is of such a nature that very few men who lack a thorough hospital training in surgical wards can hope to get through.

In America, "five to eight years after graduation in Medicine, devoted to special training and to practise, is normally the time requirement for eligibility to Fellowship." As to "special training," "at least one year must be spent as interne in a creditable hospital, and two years as surgical assistant, or evidence must be given of apprenticeship of equal value." The balance of two to five years may apparently be spent in "practise."

In Australasia, "a minimum of five years' postgraduate training in surgery under an approved senior surgeon."

(5) *Evidence of Operative Ability.*

In England none is specifically demanded, although the majority of candidates have in their hospital training acquired a certain competency in operating.

In Australasia the same is true but the evidence of the senior surgeon or surgeons under whom the apprenticeship has been served is relied on for information in this respect.

In America the submission of 50 case records of patients upon whom the candidate has himself operated, and of 50 abstracts of case records of patients at whose operations he has acted as assistant.

Such a comparison must lead, in all of us, to some opinion concerning relative merits. For my own part, I feel that it is legitimate to express a personal opinion quite frankly. And that opinion is in favor of the Australasian system, because it alone satisfies my, possibly old-fashioned, ideals. A good practical knowledge of the basic sciences, including surgical pathology, and a relatively long apprenticeship under the direct supervision of a surgeon of unquestioned authority, ought to constitute the essentials in the training of a real surgeon. The other systems lack one or both of these requirements.

At the beginning of these remarks, I made a plea for the establishment of a higher degree in surgery in this country. That obviously implied a dissatisfaction with the only degree we now have, that of the F.A.C.S. The chief ideas in my mind were, first, that that part of the general public not served by high-class hospitals had still an equal need of well trained surgeons; and, second, that the American College of Surgeons was not properly supply-

ing that need in respect of the qualifications of its Fellows as surgical specialists. This amounts to saying that the requirements of admission demanded too little of the candidates. The Regents in 1914, to meet an emergency, made the standards of admission relatively low (as compared with England), as a matter of material policy. That policy was, however, also idealistic in its program of education. To you here present, most of whom are Fellows of the College, it is unnecessary to emphasize the real achievement which this policy of education has accomplished in elevating surgical standards throughout the country, or to point out the large amount of progressive work along selected lines which has been carried out by the College in its inspection of hospitals, its committees on bone sarcoma, fractures, cancer clinics, surgical education, and the rest. But we have to remember that this educational part of the College work is done by the leaders, by the highest type of surgeon that America produces. It is finer, more extensive, more effective than that carried on by any other surgical society of which I know.

But what about that other and greater side of its work, the Fellowship? What about the Requirements for Admission? In principle, if the rank and file of the candidates are admitted too easily, by tests which are too easy, it can do nothing but lower the general name and reputation of the College. It is not enough to say that men may justifiably be admitted easily in order to educate them to higher standards. A certain reasonably high level of attainment on the part of its new Fellows ought to be exacted by the College, because the good name of the College will chiefly stand or fall upon the reputation of its individual Fellows practising in their individual communities. Therefore, that part of the College's original policy definitely announced by the Director General in 1914 which aimed at numbers, at having "every surgeon on the Continent who can fulfil the membership requirements become a Fellow of the organization," which consisted of gathering in as many applicants as possible for Fellowship, in urging Credentials Committees in all states and provinces to bring in by suggestion and encouragement all possible candidates (the "highways and hedges" policy, as it has been called), has naturally given some justification for the criticism of those who thought that the standard of requirements for admission to Fellowship was being sacrificed in favor of the ideal of numbers as opposed to the ideal of unimpeachable qualifications.

It has always seemed to me in reading the yearbook of the College, and the addresses pronounced at Congresses by the Founders and leaders, that there was a curious contradiction between these two policies. The requirements for admission to Fellowship, in regard to knowledge, seemed, at any rate to many of us, much too lax in respect of surgical knowledge, yet the aspirations of the leaders were always high. Let me quote a few paragraphs from various addresses:

In 1913, at the Third Convocation, Doctor Bradford said: "It has been said by those who undertake to study the American people that the typical American, although energetic, resourceful, and venturesome, *lacks a knowledge of fundamentals*. He has the defects as well as the virtues of the pioneer. Are these traits characteristic of the Amer-

ican surgeon? If they are, the facts should be reckoned with in our plans for the training and education of our surgeons. We should foster the energy of the pioneer and give to him the *fundamental knowledge needed by a master.*"

In 1929, Dr. W. J. Mayo, in the Fellowship Address, said: "I hope that the time will come when every young surgeon, after special training of at least three years, will take a *master's degree in surgery*, and will train himself with a view of gaining surgical recognition that will entitle him to join the College: You may become a good operator by staying at home and sticking strictly to business, but not a good surgeon. It is the *mental outlook of the surgeon and not the hands that is most important.*"\*

These should be our ideals. But can we claim that the requirements for admission as formulated by the Founders of the College satisfied those ideals? I should answer "yes," as regards the character of candidates, but "no" as regards the evidence of their surgical knowledge and skill.

It may be urged that standards and ideals differ greatly, and that the standard of the Fellowship does fulfil a reasonable ideal. Any argument presupposes an agreement upon definitions. What is the definition, at the present day, of the term surgeon? I conceive of it thus: In ancient Greece, the surgeon was, as the etymology of the word shows, "one who worked with his hands." There are some, even in these times, whose conception of the surgeon rises no higher. But we may accept skill in handicraft as an integral part of the definition. The surgeon should know how to do the mechanical side of his job. That is called the Art of Surgery. What must he know of the Science of Surgery? As the abnormal is derived from the normal, the surgeon must be familiar with both. He must know his surgical applied anatomy, both normal and pathologic, and his surgical applied physiology, and his surgical applied biochemistry, and his surgical pathology, for all of them are necessary to the understanding and to the intelligent treatment of surgical diseases and injuries. I say "applied" to indicate that an extensive knowledge of "pure" anatomy, physiology, and so on, is not to be demanded, but only a knowledge of fundamentals and their application to the science and art of surgery. Yet, these are the basic sciences; and lacking a reasonable knowledge of them, the surgeon is no true surgeon but an empiricist, a rule-of-thumb man. *Rerum cognoscere causas!* The empiric and the charlatan know nothing of causes; the surgeon must. It is the basic sciences which enable him to trace causes, and so to understand disease.

The third requisite is clinical experience, that is, at the bedside, and necessarily in a large hospital. This gives the young surgeon knowledge through repetition and variety. But in order that he should not gain experience at the expense of the patient, he must be taught by one of the elders, and guided. He must, therefore, be apprenticed to a Master Surgeon, and for a reasonably long period.

From this argument I deduce that a sound knowledge of the basic sciences and a long apprenticeship under a Master in the Guild are the chief requisites in the development of the surgeon. And they are requisites alike for the small-town surgeon and for him of the metropolis.

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\* (Italics the writer's.)



## HIGHER DEGREES IN SURGERY

How, then, is the apprentice to gain the coveted title of surgeon? How but by examination? How save through the imprimatur of the Masters?

Who should set the standards of such examinations? Surely the Guild Masters. Who should award the title? Again the Masters of the Guild of Surgeons. And if the standards set by the Guild Masters are low, if the examination is made easy, if basic sciences are counted unnecessary, if the apprenticeship term is short, if the handicraft is exalted and science is made little of, then will the value of the Guild's title of surgeon be counted low.

If these principles are accepted, if we hold to these ideals, then the questions at issue are:

First, by what means can we best provide the country with a sufficient number of surgeons who fulfil these ideals?

Second, assuming that the Fellowship of the American College of Surgeons is at present the only degree or diploma which certifies to the public that the holder is a "surgeon," or specialist in surgery, are the tests leading to the acquirement of such Fellowship sufficiently stringent to assure these ideals?

Third, if we conclude that they are not, then what measures should be taken to remedy this state of affairs? Should the College's system of examinations be altered or added to in order to make admission more difficult, to demand a deeper and wider knowledge of surgery? Or should we establish an independent Board of Examiners with power to grant a higher degree to successful candidates, say Master in Surgery? (This last is no new idea. Doctor Bevan suggested, though in another connection, in his Presidential Address two years ago, the creation of a new degree, that of Master of Surgery.)

For my own part, I can only record personal opinions. In doing so, I desire most sincerely to avoid being dogmatic or hypercritical. I know from correspondence and discussion that some, probably many, of the leaders of the College are genuinely convinced of the soundness of the system, and that, certain defects admitted, they are steadily endeavoring to improve it. Our difference is one of principle; and that concerns chiefly the character of the examination (one hundred case reports) and the kind and duration of the apprenticeship period. Answering, then, the questions at issue just posed, I venture to make a few observations and suggestions.

The means of providing the country with surgeons of the ideal stamp are to be found in the establishment of a Board of Examiners who hold these ideals; and also by a wider and better organized system of utilizing our outstanding hospital services throughout the country for the training of such prospective surgeons.

I cannot but feel that the Admission requirements of the American College of Surgeons are not stringent enough to assure such ideals. In what ways, then, are they lacking? The number of State and Provincial Credentials Committees must amount to close upon 60. Their judgment upon the moral and ethical fitness of candidates may well be accepted, but their standards

as regards training, scientific knowledge and operative ability must vary considerably from State to State, and may easily be set too low.

The system of 100 case records as representing a final examination allows too easily "leaks" of various sorts, and gives too little information concerning the candidate's surgical capacity, either in judgment or in handicraft. There is lacking the intimate knowledge of the candidate's ability which is provided in the Australasian system by the supervision of a senior surgeon. The record of 50 major operations "unaided and unsupervised," may mean much, it is true, but may mean very little.

The candidate is rarely, if ever, seen by the Board of Examiners who pass him. A very small percentage are ultimately rejected. The system tends to emphasize ability to perform routine operations, without taking much account of the candidate's knowledge of the science of surgery. Can such case records make clear his knowledge of anatomy, physiology, pathology, or even operative technic? Do they include any reasonably wide variety of surgical diseases and operations? In short, is the system of case reports sound? For my own part, I think it is not. It was designed to give the public a guarantee that the holder of the diploma was a better surgeon than the type which previously flourished; and to provide quickly a large number of practical surgeons to displace these. As a result the College has given its Fellowship in the 21 years since its founding in 1913, and including the original 450 Founders, to a total of 13,895 surgeons. That makes on my computation (very roughly) about one surgeon to every seven or eight medical graduates in general practise, excluding those who take up specialties or go into State or institutional service. And with that we have not counted the large number of surgeons who do not belong to the American College of Surgeons. The very number indicates that the standard of admission is, to say the least, not exacting. Is it not time to take a step higher? (The Royal College of Surgeons of England has admitted in the last sixty years less than 2,000 Fellows!)

In saying all this, I do not wish to indicate that the rank and file of the Fellows are on the average unworthy members of the surgical profession (though some are!) They have had a surgical training of sorts, often of a very good sort; and they undoubtedly do a vast amount of creditable surgery. But I do feel that the title of F.A.C.S. is too high, too fine a one for many of those who are accepted. The dignity of the title has been lowered by too easy admission. The weight and significance it carries with the public is also undeserved by the surgical knowledge of not a few of those to whom it is granted.

My plea, therefore, is that some new departure be now made, some new step taken, with the object of making better provision for the country's need of thoroughly trained surgeons, and of augmenting the dignity of the surgical profession on this continent. My belief is that we can only do this by creating an independent higher degree demanding a stricter examination, both in fundamental principles and in practice. Whether that degree should be created inside the American College of Surgeons, or outside it, or perhaps

preferably, by a collaboration of all representative surgical associations, I leave undecided. A general board, consisting of representatives from this Association, the American College of Surgeons, the Surgical Section of the American Medical Association, the Federal Examining Board, the Universities, and possibly others, is what naturally suggests itself. Such a Board, demanding a reasonably high level of surgical knowledge and skill, and awarding by examination a new and higher degree, would safeguard the public, satisfy our own sense of rightness, and do much to raise, in the average, the reputation of American Surgery.

The *modus operandi* of establishing such a higher degree, or certificate, presents undoubted difficulties of detail. But the work already done in various countries, and especially by the Council on Medical Education of the American Medical Association, on qualifications of specialists, should form a good lead. Time is lacking to review this aspect of the subject, and I fear that I have far overstepped my time. Perhaps a President's privilege may excuse that!

Gentlemen, our profession is sometimes, by the more emotional of our patients called "noble." Let us neglect the somewhat hackneyed implication of the word and realize that the phrase is, or should be, essentially true. From Hippocrates to our day those who have practised the healing art have had the blessed heritage of the Hippocratic Oath,—that pledge which lends to a profession already made fine by service a peculiar worthiness and dignity. And Old Burton said somewhere in his *Anatomy of Melancholy*: "One thing I would require of every physician—honesty!" To that we may well add, in these wonderful times of increased and rapidly increasing knowledge, judgment and skill. These we owe as professional obligations to our patients. But this is not all. One more duty is incumbent upon us; that of providing or helping to provide workers of undoubted capacity as our successors.

In our hands as surgeons are the graver issues, not seldom of life—or of death! And that more immediately than in any other branch of medicine, because we oppose disease by an act which of itself may bring danger. Dame Nature often presents prematurely her account for the debt which ultimately is due her from all of us. Ours is the task and privilege of interfering to prevent payment before the proper date of maturity. That can best be done if we, and those we teach, acquire the judgment and skill necessary to defeat the Old Dame! Those we teach! Yes, but also examine. For our successors should be better surgeons than we are. Our Guild has its Masters; and we must see to it that our apprentices, by instruction *and through examination*, become Masters. This, in brief, is the thought that underlies all that I have said this morning. We must continually strive, for our posterity as well as for ourselves, towards higher standards in that profession which is at once our anxiety, our pride, and, I trust, sometimes our glory.

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UNDERGRADUATE TEACHING OF SURGERY

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GRADUATE TEACHING OF SURGERY IN UNIVERSITY CLINICS

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OPPORTUNITIES FOR GRADUATE TEACHING OF SURGERY  
IN LARGER QUALIFIED HOSPITALS

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DISCUSSIONS BY

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## UNDERGRADUATE TEACHING OF SURGERY

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BOSTON, MASS.

MOST of those assembled here are teachers by profession and all are teachers in fact, for all successful doctors are thoroughly imbued with these lines of the Hippocratic oath, "To teach them this art if they shall wish to learn it." Thus the exercises of today are a part of our faith and are to be treated as an expression of our most sincere thought. Medical education in the last 30 years has undergone an enormous change, a change of tremendous benefit to the public welfare. The American Medical Association began in 1907 classifying medical schools on the basis of their buildings, equipment, personnel, administration, and the results of the examination of the graduates of each school for the license to practice medicine. In 1910 appeared the Flexner report to the Carnegie Foundation for the Advancement of Teaching on "Medical Education in the United States and Canada." In 1925 the Commission on Medical Education was organized by the Association of American Medical Colleges and has issued both in pamphlet and book form careful studies of the whole subject of medical education. During this period of 30 years, under the pressure of criticism and suggestions from commissions and individuals, our medical schools have been practically rebuilt and entirely reorganized. Vast sums have been given not only for the practical construction of satisfactory teaching units, but for the endowment of the teaching force itself. The struggle for efficiency has resulted in a very satisfactory competition, a competition ultimately giving to us the survival of the fit and the loss of schools which could not or did not find the funds to improve their material, equipment, and their teaching force. As a result, in 1934 there were 77 Class A or approved medical schools with 22,799 students, as against 160 schools of this type in 1905 with an enrollment of 26,147 as recorded in the first report of the Council on Medical Education and Hospitals of the American Medical Association in 1907.

Unfortunately, the impetus toward improvement has been entirely upon undergraduate education and we have now reached the peculiar position in our country where we turn out a great number of well trained young men from our medical schools, but have a totally inadequate mechanism for giving them the necessary practical and special training and experience during the first few years after graduation, so that they may practice the dangerous specialties of their profession with safety. This lack is perhaps more glaring in relation to surgery and its specialties because of the actual danger inherent in surgical practice, but roentgenology, also a dangerous technic, is in a similar situation, and the medical specialties, though not so apt to result in serious mistakes of commission, are from the point of view of the public health in a similar position. Legally there are no restrictions once a graduate has passed his state



licensing board examinations and this is a matter generally undertaken and completed immediately upon graduation from the medical school. Thus the American public may legally be cared for, indeed, subjected to a dangerous surgical procedure, by a student who has just been graduated from medical school.

This creates an entirely anomalous situation, for, as we shall see later, every teacher of repute in the realm of surgery agrees that it is not his duty to teach the undergraduate medical student practical surgery. He feels it his task to train the young student in the principles of surgery, the basis of asepsis, gentleness, support, the principles of anesthesia and how to care for trauma and minor sepsis, matters which constitute such a large share of the general practice of medicine. And our good teachers are almost unanimous in their opinion that the teaching of the technical steps of major surgery is a post-graduate problem. This means that we teach less technical surgery than 20 years ago, but that we permit (legally) this untrained individual to practice his art upon, let us be frank, the unsuspecting public. We cannot allow this situation to persist and it is clear that the problem which is to be confronted will largely be concerned with this graduate education which we have so sorely neglected. It is our responsibility and our duty to see that steps are now taken to remedy this matter.

As an introduction to the phase of graduate and postgraduate training of the surgeon, there must be some statement of what his equipment is or should be by the time he graduates from medical school. Surgery is definitely a post-graduate problem. At the same time, since a large proportion of the general practitioner's patients suffer from disorders for which minor surgery is the chief therapeutic agent, every medical school must provide its students with teaching and experience in the elements and principles of surgery and particularly in the care of individuals suffering from injury and infection. This necessitates grounding in the matter of asepsis, sterilization and the whole relation of bacteriology to clinical surgery. It necessitates a satisfactory knowledge of the ability of the body to repair damage and thus courses in surgical pathology—the healing of the wound and the reaction to foreign bodies—are necessary parts of the early training of our young undergraduate medical student. This matter also necessitates competent knowledge and training in the use of the simpler anesthetics. I have long looked upon the principles of surgery as the methods by which we obviate pain, hemorrhage, and sepsis, and I feel that if a student is well grounded in the meaning of these simple conditions and has some practical clinical experience in the realm of trauma and sepsis, he is competent to care for the simpler injuries and infections which come to the office of a general practitioner.

In addition to such training, the undergraduate student must be shown by members of the department of surgery those forms of disease for which surgery is the chief therapeutic agent. It is only proper that the surgeon should teach concerning the disorders which he cares for, demonstrating these

to the students not from the point of view of the therapy but so that the students may know which disorders should be treated by surgery and also know something of the dangers and complications of the surgical undertaking. This necessity of discussing disorders for which surgery is the chief therapeutic agent also clearly points out that the surgeon must share in the original instruction given to medical students in history taking and physical diagnosis, which are our fundamental methods in reaching a diagnosis. For example, the surgeon is the one to teach the medical student proper abdominal examination. He is the one with the greater experience concerning the art of distinguishing between voluntary and involuntary spasm, having learned this by proving his diagnosis daily in the operating room. He also is the one who must teach many of the special examinations, the gynecologic examination, digital examination of the rectum; and his specialist colleagues must add to this the methods of examining the ears, the nasal passages, and the mouth.

Even this short list of topics is enough to consume, if these matters be properly taught, all the time a department of surgery will ever be given by a curriculum committee and should any of the time which a department of surgery is given be utilized by the students in watching operations or trying to understand the technical details of procedures, just so much less will the student know of the fundamentals upon which he is to build his education. Just how the time and the curriculum are to be divided is a matter of practical concern to the teachers, though the principles enunciated above are of far greater importance than any details of the curriculum.

The curriculum in practically all American medical schools follows the block system. The basic sciences occupy the greater part of the first two years and the last two years are given over to clinical study. Thus a study of the normal logically precedes the study of the abnormal (disease). In some centers the separation of these two considerations of medical education has been emphasized by the setting up of the basic medical sciences and the clinical work into almost separate schools. Such a tendency seems to some unwise since it accentuates the natural thought of the student that the sciences are something to get through with in order to study medicine. But in all schools there are given at some time between the training in the medical sciences and the clinical years general introductory courses in medicine and surgery. The chief aim of such propaedeutical instruction is to equip the students with methods and tests for determining the normal and its variations. Thus history taking and physical diagnosis which constitute our chief clinical methods occupy this first time in clinical teaching. It is true that the department of surgery in some schools assists in the teaching of anatomy but beginning at this time it must assume a major responsibility. Here arises the question as to how much instruction in history taking and physical diagnosis the surgeon is to give. Shall he, independent of what his sister department of medicine is teaching, cover the whole field? In some schools this seems to be the case,

though in the majority of schools the chief instruction in this important matter is given entirely to the department of medicine. In a few schools excellent cooperation obtains between the departments and in such schools the responsibility for special examinations only is left to the surgeon. Thus the abdominal examination, the rectal examination, and the vaginal examination belong to the general surgeon, the neurologic examination to the neurologist, and the examination of the eye, ear, nose and throat to the appropriate specialist. It is fair to point out that the correct handling of this introductory course is less well standardized than the remainder of the teaching. In some schools only history taking and physical diagnosis occur at this time; in others, courses in surgical technic, the methods of sterilization, enough surgical pathology at least to cover the healing of the wound, the principles of anesthesia and the beginnings of a study of trauma and sepsis, though both laboratory and clinical experience, precede the actual contact with patients.

The curriculum for the last two years is well standardized. Didactic lectures and clinics give to the student a skeleton of regional surgery on which to hang his varied ward and out-patient experiences. The exact order of these last two years is somewhat divided. In about one quarter of the schools the third year men are clinical clerks on the wards, and in the quiet of such surroundings, with plenty of time, begin to practice history taking and physical diagnosis. In such schools the student spends his last year in the dispensary or out-patient department. But in the majority of schools this order is still reversed and the third year students in small groups with an instructor are acquainted with disease in the out-patient departments, spending their fourth year on the hospital wards as clinical clerks. It seems to me that there is little to choose between in the methods if both are well done, for the objection that the rush and bustle of an out-patient department is no place for a beginner may not be true if special rooms and a competent instructor are available, and the very variety of material, and especially the emphasis on trauma and infection, may be of great value at this time.

Some years ago the American College of Surgeons made a start in studying the education of the surgeon, but the College found greater interest in other matters and even reports of the studies made at that time were not published. Now, some years later, the original studies started at that time have been amplified and we can today present to you the opinions of the heads of teaching departments in 51 of the 77 Class A or approved medical schools in this country. The unanimity of opinion concerning undergraduate education is so striking that there can be little doubt but that this phase of surgical education is now well understood, well standardized, and fairly well taught in practically all of our Grade A schools. Moreover, I have had the opportunity in the last five years to visit at least 20 of our leading schools and in addition to what the professors in charge have said have had ample opportunity to get the student's reaction, both during his undergraduate days and immediately upon graduation. The standardization of undergraduate education is almost startling. It is true that the teaching of fractures, anes-

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thetia and the amount of time given to the surgical specialties all vary widely, but that is largely because of the type and supply of material, not because the teachers themselves have a divergent opinion of what it is wisest to teach.

The original questionnaire sent out to the Class A medical schools contained the following general and specific questions:

TABLE I

- (A) What are the important matters to teach the undergraduate medical student? (Comments here on over- or under-emphasis of specialties would strongly apply.)
- (B) What is the order of teaching (by topics in years)?
- (C) How much time in general is required in the curriculum?
- (D) We would in particular like specific answers to the following questions:
  - (1) What do you consider the most important matters for a department of surgery to give to undergraduate medical students?
  - (2) Do you consider it your duty to teach practical operative surgery?
  - (3) Do you teach sufficiently well and do you have time and materials enough in your curriculum to satisfy yourself that you are covering carefully the following:
    - (a) the care of trauma, including fractures;
    - (b) the care of ordinary sepsis;
    - (c) anesthesia?

The answers to these questions are summarized in Tables II, III, IV, and V.

TABLE II

## *What Are the Important Matters to Teach the Undergraduate Medical Student?*

Surgical diagnosis.....	32
The principles of surgery.....	30
Keep specialties in the background.....	28
The basic courses.....	16
Trauma and sepsis.....	13
Clinical surgery.....	8
The indications for surgery.....	5
Ambulatory surgery (minor surgery).....	5
Preoperative and postoperative care.....	4

The answers to Question A, given above in Table II, are almost a summary of the other expressions which are to follow and make it very clear that the teachers of surgery consider surgical diagnosis, the principles of surgery, and the care of trauma and sepsis their first obligations. It is of interest that a majority of the teachers must see some danger in overspecialization early in the student's career, in that they have definitely stated that the specialties should not be greatly emphasized.

A study of Table III, which gives the answers to Question B, shows some variability in the exact sequence of teaching topics, but on the whole there is not so much divergence as the number of specific courses would seem to indicate. In the first year, two schools do teach surgical anatomy, one minor sur-

gery and one gives amphitheater clinics. As a matter of fact, in a good many schools the teachers in the department of surgery do assist in the anatomic instruction, and quite properly so, but their responsibility is, in these schools, in the department of anatomy and not in the department of surgery.

For practical considerations, we may say the first year is devoted entirely to the basic medical sciences.

TABLE III

*What Is the Order of Teaching (by Topics in Years)?*

<i>First Year</i>			
Surgical anatomy.....	2	Orthopedics.....	5
Physiology.....	1	Animal surgery.....	5
Biologic chemistry.....	1	Urology.....	4
Neuro-anatomy.....	1	Anesthesia.....	4
Histology.....	1	Regional surgery.....	3
Dissection.....	1	Specialties.....	3
Minor surgery.....	1	Anatomy.....	2
Surgical amphitheater clinics.....	1	Abdominal surgery.....	1
		Tumors.....	1
		Diseases of rectum.....	1
		Externship.....	1
<i>Second Year</i>		Surg. body, surface and extrem.....	1
Principles of surgery.....	17	Medicine.....	1
Minor surgery.....	9	Public health.....	1
Basic sciences.....	8		
Physical diagnosis.....	7	<i>Fourth Year</i>	
Surgical anatomy.....	6	Clinical clerkship.....	30
Surgical lectures.....	5	General surg. clinic.....	16
Clinical teaching.....	3	Out-pt. case taking and dispensary.....	14
Dry clinics.....	3	Surgical pathology.....	9
History of surgery.....	2	Ward rounds.....	8
Surgical technic.....	1	Gen. surg. lectures.....	6
Medicine.....	1	Anesthesia.....	6
Fractures I.....	1	Surgical diagnosis.....	6
		Regional surgery.....	5
<i>Third Year</i>		Operating room work.....	5
Didactic course in surgery.....	17	Special clinics.....	4
Dispensary teaching.....	15	G-U lectures.....	4
Principles of surgery.....	13	Specialties.....	3
Surgical pathology.....	13	Surg. head, thorax, abdomen.....	2
Fractures.....	12	Roentgenology.....	2
General surgical clinic.....	12	Neurologic surgery.....	2
Surgical diagnosis.....	9	Surgical anatomy.....	2
Clinical clerkship.....	8	Industrial surgery.....	2
Operative technic.....	7	Orthopedics.....	2
Examinations and case taking.....	6	Animal surgery.....	1
Ward rounds.....	5		

In the second year occurs the introductory course in surgery, given different names, apparently, in different schools. Thus, though the title "principles of surgery" receives the greatest number of votes, minor surgery, physical diagnosis, surgical lectures, clinical teaching, surgical diagnosis, *etc.*, might well all be classified under the same heading.



In the third year there is a great array of topics under which the department of surgery teaches. Apparently, in some schools the principles of surgery do not begin until the third year, and in these schools, indeed, there is no surgical teaching in the second year. On the whole, dispensary teaching and a didactic course, as a skeleton on which the students are to hang their general experience, constitute the major items in that year. The course in surgical pathology appears as a part of the surgical curriculum in some schools, but in others this topic through cooperation is taught by the department of pathology, so that the figures here do not necessarily mean that surgical pathology is taught in only 13 schools. The eight schools which give a clinical clerkship in the third year instead of the fourth year are, as a rule, greatly pleased with this shift of the curriculum and feel that the student should practice early in his career his methods of history taking and physical diagnosis and can practice them, indeed, to better effect in the quiet of the ward than in the busy dispensary. This is the only really important consideration in these last two years, for the remainder of the topics taught and listed here are fitted into most schools in one way or another even if they do not appear as separate courses.

In the fourth year the general clinical clerkship, supported by a surgical clinic once a week, is the usual method of teaching. In some schools, as already noted, the fourth year men work in the dispensary and out-patient department and, indeed, in some of the schools, where the clinical clerkship occurs in the fourth year, these men are in addition sent out for a more varied experience, for a part of this period of training, to the out-patient department. The general list of other topics shows again some separate courses in surgical pathology and in some schools ward rounds are listed as a separate course, and operating room work and some specialties creep in as special courses. The large number of topics, however, does not at all express the unanimity of the form of teaching but merely means that different teachers give different names to their courses. For example, one school lists only a clinical clerkship, whereas during this clinical clerkship there is teaching in surgical pathology, ward rounds, operating room work, instruction in the specialties—matters which in another school are all listed separately.

The answers to Question C, "How much time in general is required in the curriculum?", were so involved with peculiarities of the curricula in many schools that only a few seemed of value in this summary. I found difficulty in counting hours since in some schools laboratory and clinical hours are graded as only half the value of lecture hours. In the 13 schools where a reasonably accurate comparison could be made, second year teaching averaged 49 hours, third year teaching, 257 hours, and fourth year teaching, 329 hours, giving an average total surgical hours in the curricula of 637 hours. Unfortunately, I have not the total curriculum hours for these 13 schools, so that the relation of this 637 to the total is not available. The total is probably in the neighborhood of 3,500 hours.

TABLE IV

*What Do You Consider the Most Important Matters for  
a Department of Surgery to Give to Undergraduate  
Medical Students?*

Surgical diagnosis and clinical surgery.....	38
Principles of surgery.....	30
Surgical pathology.....	19
Indications for surgery.....	13
Trauma and sepsis.....	11
Basic sciences.....	9
Physical examination of patients.....	8
Minor surgery.....	5
Urgent surgery.....	3
History of surgery.....	2
Knowledge of literature.....	1
Preoperative and postoperative care.....	1
Laboratory.....	1
Roentgenology.....	1
Urology.....	1

Table IV, the answer to Question D-1, was specifically asked as a check on Question A and merely reemphasizes that the great weight of opinion is in favor of teaching the principles of surgery and surgical diagnosis. Again also we see emphasized the teaching of trauma and sepsis which constitutes such a large share of the general practitioner's work.

TABLE V

*Do You Consider It Your Duty to Teach Practical  
Operative Surgery?*

No.....	40
Yes, as far as surgical technic is concerned.....	12
Yes.....	6
Yes, as far as animal surgery is concerned.....	5
No, but assist at a certain number of operations..	1
Doubtful.....	1

Table V was worded so as to make the teachers take a definite stand on the teaching of operative surgery. Note that only a negligible percentage of teachers feel that they should teach practical operative surgery.

The final question, D-3, "Do you teach sufficiently well and do you have time and materials enough in your curriculum to satisfy yourself that you are covering carefully the following: (a) The care of trauma, including fractures; (b) the care of ordinary sepsis, and anesthesia", was asked to determine specifically the teaching of matters that are essential to the education of the general practitioner of medicine. The 51 answers were practically unanimous that they had both time and materials to cover thoroughly the teaching of trauma, including fractures, and sepsis. But there were many who agreed that anesthesia was poorly taught. Thirty professors felt that they had time and material to teach anesthesia, but 19 were definite in their opinion that they had neither time nor material, and three were doubtful whether with their set

up this was possible. This problem of anesthesia is, indeed, perhaps the most flagrant gap in the student's education, and it is a sad commentary that in America where such a great impetus was given to the art of anesthesia we should now neglect it. It also must have an unfortunate reflection on public opinion, for almost every doctor must from time to time, by the very fact of his degree and supposed learning, give an anesthetic, and if only to save our graduates embarrassment we should remedy this part of our teaching.

There are many forces, of course, which are acting to cut down instruction in anesthesia, largely its standardization 20 years ago to a few inhalation anesthetics and local infiltration anesthesia, which resulted in the advent of the nurse anesthetist. It was found that nurses could be easily taught the safe and proper use of the various inhalation anesthetics then in use and, as this cut down the cost of surgery both for hospitals and the public, this form of practice was popularized. Now, however, things are different. A great array of very valuable drugs, dealing with the art of anesthesia, have recently been introduced into the profession and the nurse anesthetist is now no longer competent to assay the value of or even practice the use of the many diverse drugs which have been proposed. It is quite proper, therefore, that at this time we take a step forward and try to fill this gap in the student's education by providing more efficient instruction in the art of anesthesia. We shall find ourselves hard pressed to do this, for only a few doctors go into this branch of medical practice and of those only a few are qualified to teach others.

#### SUMMARY

In a review of the present status of the undergraduate education of the surgeon in the United States, it is clear that all of our approved or Class A medical schools are well standardized in the general methods of teaching surgery. It is obvious that the chief stress is laid upon teaching the principles of surgery, surgical diagnosis, and giving to the students an opportunity to study, in the dispensary and at the bedside, a sufficient number of cases to acquaint them at first hand with the extent, the benefits, and the dangers of surgical therapy. It is obvious that there is great unanimity in keeping the education general, avoiding emphasis on the specialties, and that the curriculum as a whole is set up to ground the students in the essentials and to acquaint them specifically with methods of caring for trauma and sepsis. It is clear that the teaching of anesthesia is inadequate and should be remedied. It is particularly clear that the teachers of surgery do not think it is their duty, and indeed do not attempt to teach practical surgery to undergraduate medical students. The corollary to this is that the real education of the surgeon is a postgraduate affair.

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- <sup>15</sup> *Final Report of the Commission on Medical Education*, 1932.
- <sup>16</sup> *Medical Education in the United States and Canada. Annual Presentation of Educational Data for 1931-1932 by the Council on Medical Education and Hospitals*. *Jour. Am. Med. Assn.*, vol. 99, pp. 736-764, 1932.
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## GRADUATE TEACHING OF SURGERY IN UNIVERSITY CLINICS

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GRADUATE teaching of surgery which has for its purpose the development of men qualified to assume the leadership in the practice of surgery in the various communities of the country and to continue the teaching of surgery in our medical schools is, in my opinion, the most important educational problem confronting the surgical profession. No matter which of the many important questions now perplexing us we subject to analysis, we come back eventually to graduate teaching of surgery as one important means of solving our surgical difficulties. It is a matter, then, which deserves our earnest consideration, especially at this time when dissatisfaction with medical practice seems widespread and profound changes in it appear possible.

Graduate teaching of surgery, in a real sense, may be said to have been inaugurated in this country by W. S. Halsted about 1900 at the Johns Hopkins Medical School and Hospital. In the annual address on medicine at Yale University published in 1904, he pointed out the need for advanced training in surgery in this country, emphasized the eagerness of young men to embrace this training and described a form of surgical education to equip a young man for teaching and practice. Its distinctive features were a long and continuous period of residence in a teaching hospital (up to ten years) in intimate contact with surgical teachers, large clinical material, laboratories, teaching and research and the development of independent work through the responsibility for the care both in the wards and the operating rooms of patients coming to the hospital. Halsted, therefore, developed a method of teaching surgery and, through experience, determined the duration and scope of a surgical education, which to him was necessary properly to equip a young man for a surgical career. The results of his educational efforts, in the form of a long list of men distinguished in teaching, practice and research must be well known to you.

In the space of 35 years since Halsted began his educational program, graduate teaching of surgery has gradually spread in one form or another throughout this country. Naturally the medical schools and particularly the university medical schools have taken the leadership in this educational growth and, as I shall presently indicate, some form of graduate instruction in surgery may now be obtained in 39 of the 59 medical schools of the country which I have studied. Gratifying as this development may be, it is obvious that it does not meet the present situation. The reports of teachers of surgery indicate, as I have repeatedly pointed out, that the number of men who each year seek opportunities for advanced work in surgery far exceeds the opportunities



available to them. The growing demand for better training in general surgery, the agitation regarding licensure to practice and the qualifications for admission to specialist organizations—all imply that facilities for advanced education in surgery should be increased. But before an increase in such facilities may properly be undertaken, it would seem important to know the status of graduate teaching of surgery in our medical schools as it exists today and to consider the opinions of those of experience as to what it should be.

Several years ago I began a study of graduate teaching of surgery in the medical schools of the United States and Canada. I sent out, with the cooperation of Dr. Fred Zappfe, a long questionnaire to the heads of the surgical departments of all the recognized medical schools and I wish to take this opportunity sincerely to thank those who were good enough to respond. I have assembled the data regarding the graduate teaching of surgery, as at present carried out, of 59 medical schools and in addition have obtained the opinions of their heads of departments regarding certain aspects of the subject which I think of importance. From the data assembled I shall present briefly: (A) The method, duration, scope and recognition of graduate instruction as it now exists in 59 of the recognized medical schools of the country and (B) the opinions of the heads of surgical departments of the same 59 medical schools as to the kind of graduate instruction they would give were it possible, regardless of what they are now giving.

(A) In a study of the method, duration, scope and recognition of graduate instruction it is found that the 59 medical schools or University Clinics fall more or less naturally into four groups. These are (1) a group of 20 medical schools which fail to offer any graduate instruction in surgery; a number which represents 33.9 per cent of the total number of schools of which I have data; (2) a group of six medical schools in which the period of graduate instruction is less than three years in duration; (3) a group of 18 medical schools in which the course of graduate instruction is from three to four years in duration; (4) a group of 15 medical schools in which the course of graduate instruction is a minimum of five years and may extend over a period of six, seven or eight years.

The data regarding Groups 2, 3 and 4 may be presented briefly as follows:

Group 2. (a) Number of schools included: six.

(b) Method of instruction: resident system.

(c) Duration of course in graduate instruction: less than three years.

(d) Educational requirements: graduation from a medical school, four; graduation from a medical school plus one year's internship, two.

(e) Instruction and experience in Surgical Pathology: none or very scanty, four; three months' experience, one; six months' experience, one.

(f) Instruction and experience in Surgical Research Laboratory: none or very little, six.

(g) Instruction and experience in Inhalation Anesthesia: none or very little in six.

(h) Instruction and experience in the Specialties of Surgery: instruction

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and experience in Urology, Orthopedic Surgery and Gynecology is obtained in connection with the general surgical service in four schools; in a two months' service in each specialty in one school; and not acquired in one school at all.

(i) Instruction and experience in the treatment of Fractures: in one school there is no instruction or experience in the treatment of Fractures. In five schools such experience is gained on the general surgical service.

(j) Instruction and experience in General Surgery: in five schools this is obtained over a period of from six months to two years in the wards and operating rooms. In one school a short course only in Abdominal Surgery is offered.

(k) Instruction and experience in Operative Surgery: in all schools (six) this is obtained by assisting senior surgeons. In four schools the men in training are permitted to do a small number of operations under the direction and assistance of a senior surgeon. In five schools the men in training are not permitted to do any operations independently. In one school a resident is permitted to do about ten selected operations independently.

(l) Recognition of advanced work by Degree: one school grants a degree but the kind of degree is not stated; one school will grant a degree upon the basis of research work. Four schools do not grant a degree for advanced work in Surgery.

Group 3. (a) Number of Schools included: 18.

(b) Method of instruction: Resident or Fellowship system.

(c) Duration of course of graduate instruction: from three to four years. The course is three years in eight schools; may be more than three years in ten schools. In the latter group the course may extend over four years, and in some there is the possibility of extending the training of exceptional men to five years.

(d) Educational requirements for Admission: Graduation from a recognized medical school, six; graduation from medical school plus one year's internship, ten; plus two years' internship, two.

(e) Instruction and experience in Surgical Pathology: This is elective in one school; covers two months in one school; three months in three schools; four months in one school; and at least six months in 12 schools.

(f) Instruction and experience in Surgical Research Laboratory: in four schools this is omitted or optional; is very little in four; covers a period of three months in two; covers at least six months in six; and is stated to be more or less continuous over the period of training in two schools.

(g) Instruction and experience in Inhalation Anesthesia: very little or none in 18 schools.

(h) Instruction and experience in the Specialties of Surgery: instruction and experience is not obtained in one school; and not in gynecology in another. In 14 schools approximately three months are devoted to each specialty; in three schools experience is gained on the general service which covers these specialties.

(i) Instruction and experience in the treatment of Fractures: in 15 schools fractures are included under general surgery; in three schools instruction and experience is obtained in a period of from three to six months on a special fracture service.

(j) Instruction and experience in General Surgery: this covers from six months to three or more years depending upon the time devoted to laboratories and Specialties in Surgery. In general 50 per cent of the period of training of from one and one-half to two years is devoted to general surgery in the majority of schools.

(k) Instruction and experience in Operative Surgery: this is obtained by assisting senior men, by operating under the direction of instructors and, in some schools, by the independent performance of operations. In seven schools the men in training are never allowed to operate except under supervision; in 11 schools they are allowed to operate independently. The number of operations performed by the men in training varies in 11 different schools between 50 and 350 with the larger number predominating; in six schools the number of operations is not stated.

(l) Recognition of advanced work by Degree: An advanced Degree is not given for graduate work in Surgery in 10 schools; an M.S., B.Sc. or Ph.D. is given on the same basis of graduate work in other University Departments in four schools. Four schools did not answer the question.

Group 4. (a) Number of schools included: 15.

(b) Method of Instruction: Resident or Fellowship system.

(c) Duration of course of graduate instruction: a minimum of five years with extension in some to six, seven or eight or more years.

(d) Educational requirements for admission: graduation from a Class A medical school in four schools; graduation from a Class A medical school plus one year's internship or its equivalent in 11 schools.

(e) Instruction and experience in Surgical Pathology: this is limited to three months in two schools and extends over a period of six months to one year or more in 13 schools.

(f) Instruction and experience in Surgical Research Laboratory: this is omitted in one school; limited to two months in one school, occupies a period of three months in one school and covers a period of from six months to one year or more in 12 schools.

(g) Instruction and experience in Inhalation Anesthesia: this is very little or entirely omitted in 13 schools; of less than two months' duration in one school and of four months' duration in one school.

(h) Instruction and experience in the Specialties of Surgery: in Urology this is obtained in a three months' period in one school; and in a six months' period or longer in 14 schools. In Orthopedic Surgery this is omitted in one school, is covered in three months in one school and in six months or more in 13 schools. In Gynecology instruction and experience varies greatly. It is omitted in a number of schools and varies in others from one month to one year.

(i) Instruction and experience in the Treatment of Fractures: this is omitted in one school and is presumably adequate and fairly large and obtained on a general surgical service in 14 schools. In a few of the latter a special fracture service is organized on which the graduate student serves for a period of time.

(j) Instruction and experience in General Surgery: in all of the 15 schools a period of two to three years is spent in general surgery. In general this period averages 50 per cent of the total time devoted to the advanced course in Surgery.

(k) Instruction and experience in Operative Surgery: this is obtained by assisting senior men, by operating under the guidance of senior men and by operating independently. In all 15 schools the Residents in training are permitted to operate independently. The number of operations personally performed by the men varies between 350 and 1,000 or more, the average being over 500 in 10 schools; is fairly large but not accurately stated in five schools.

(l) Recognition of advanced work by Degree: in 12 schools a degree for advanced work in Surgery is not granted. In two schools an M.S. or Ph.D. is granted under the conditions which obtain for advanced degrees in other departments. In one school a degree may be obtained, but its acquisition is discouraged by the head of the department.

(B) While it seemed to me of great interest and importance to know what is being done in graduate teaching of surgery in our medical schools, it seemed of equal importance to know what opinions regarding graduate teaching the various heads of surgical departments have formed as a result of their experience with the type of graduate teaching they themselves are doing. The second part of my questionnaire, therefore, requested an expression of opinion of the method, duration, scope and recognition of a more or less ideal course of graduate instruction—one which each head of a surgical department would inaugurate if conditions were favorable. The large majority of the Professors of Surgery in institutions in which opportunities for advanced surgical training do not obtain failed to offer opinions, some frankly stating that their lack of experience did not permit them to do so. The opinions studied, therefore, come from those who actually have had experience with graduate teaching over a variable period of time. They may be summarized as follows.

(a) *Method of Instruction.*—Forty-three heads of departments expressed themselves in favor of the Resident system or its modification (Fellowship) as a method by means of which an advanced education in surgery may best be acquired; 16 heads of departments did not offer an opinion.

(b) *Duration of Period of Advanced Training.*—One head of a surgical department is of the opinion that a course less than three years in duration is sufficient. Five heads of departments are in favor of a three years' course of graduate instruction. Five heads of departments believe that a course should embrace a minimum of three years but should be sufficiently elastic to permit certain advanced students to spend five years in acquiring a surgical training.

Eighteen teachers of surgery express themselves in favor of a period of training covering a minimum of five years. Twelve teachers of surgery are of the opinion that a period of training in excess of five years is desirable and extend the period to six, seven, or eight years. Eighteen heads of departments of surgery did not express themselves. A summary of these opinions shows that 12 per cent of the surgical teachers favor a three years' course in graduate instruction, 12 per cent a three to five years' course and 75 per cent a five to six or seven years' course of instruction.

(c) *Scope of Instruction.*—The very large majority of surgical teachers favor a fairly comprehensive training in surgery including surgical pathology, surgical research, fractures, the surgical specialties of urology, orthopedic surgery, and gynecology and general surgery, including personal experience in operative surgery. The variations in opinion concern the period of time devoted to each subject rather than to the subjects which should be covered in the course. Very few teachers seem to be concerned over the lack of training and experience in the administration of inhalation anesthesia which now is almost universal in surgical clinics. Twenty-seven surgical teachers did not favor formal instruction of any kind, but a number approved of conferences and seminars. One surgical teacher favored formal instruction in fractures and regional surgery. Thirty-one teachers did not express themselves regarding the nature of the instruction.

(d) *Recognition of Advanced Work by Degree.*—Twenty-eight surgical teachers favored an advanced University degree of some kind in recognition of the satisfactory completion of advanced work in surgery. Two surgical teachers, while not expressing themselves as opposed to a degree, questioned its value. Ten surgical teachers are opposed to a degree or think it unnecessary. Nineteen surgical teachers did not express themselves. The degrees now granted or suggested include Master of Science in Surgery, Doctor of Science in Surgery, Bachelor of Science in Surgery and Doctor of Philosophy. It is clear that there is no consensus of opinion at present regarding the degree to be granted.

(e) *Approval of Advanced Teaching of Surgery in the Larger Qualified Hospitals Not Affiliated with Medical Colleges.*—Thirty surgical teachers were of the opinion that the larger qualified hospitals might successfully undertake advanced surgical teaching provided the surgical staffs of the hospitals were experienced teachers and laboratory and other facilities were adequate. Four surgical teachers doubted that it could be done and one was opposed to the idea. Twenty-four did not venture an opinion.

#### DISCUSSION

In an appraisal of an educational program one naturally considers it from several viewpoints: from the viewpoint of the duration and subject matter, from the viewpoint of the quality of the students who participate in it, the facilities available for its successful promotion and excellence and enthusiasm of the teaching staffs which conduct it and, finally, from the viewpoint of



one's personal ideal. In the preceding analysis I have considered graduate instruction in our medical schools only from the viewpoint of its method, duration and scope, leaving out of consideration the important matter of the quality of the instruction given. This I did not have the opportunity to investigate and what value the study may have is, I realize, seriously impaired by the omission. But since I know, not all, but a large number of the surgical teachers of the schools included in this report, I think it may be fairly stated that the large majority of them are greatly interested in graduate teaching and, considering the difficulties in many schools due to unsatisfactory hospital affiliations, lack of laboratory and research facilities, restrictions in budget and limitation in personnel, are doing it very well.

An analysis of the various groups of schools shows, I think, the trend in the development of an educational program in our medical schools. It is apparent that the Resident or Fellowship system as a teaching method has been accepted as the best which thus far has been devised; it is apparent, also, that the advisability of a fairly comprehensive training in surgery including general surgery and the specialties of urology, orthopedic surgery and gynecology is generally agreed upon. As the longer courses of graduate instruction are compared with the shorter, it is evident that longer periods of time are being devoted to clinical work in general surgery and its specialties; but more striking is the emphasis upon and the increasing amount of time given to surgical pathology and experimental research in surgery. Perhaps most striking in the longer courses is the emphasis placed upon individual responsibility as a means of developing character, surgical diagnosis, technic and judgment. The gradually increasing responsibilities placed upon the graduate student (Resident) for the diagnosis, pre- and postoperative care and operative treatment of the patients in the hospital are, in my opinion, one of the most outstanding features of the longer courses of graduate instruction.

To judge the adequacy of graduate instruction as it now obtains in our medical schools one may compare the course of instruction with the ideal one hopes to attain at its completion. The ideal may vary greatly in the minds of surgical teachers. To me, the ideal end product of a course of graduate instruction is a young man who has had a rather broad fundamental training in the sciences related to medicine and, after his graduation in medicine, a long, thorough and comprehensive training in surgical pathology, surgical diagnosis, pre- and postoperative treatment and operative surgery; who has acquired the technics of, and become imbued with the desire to pursue, research; who has gained experience in teaching and departmental organization; and who has learned to know the ethics of the profession. In short, he is one for whom, at the completion of his training, his surgical teacher is ready and eager to stand sponsor either as equipped for a teaching career or as fully qualified to practice surgery.

If it is agreed that this ideal is the objective of graduate teaching, it must be admitted that the courses of graduate instruction of three years or less now given in many of our medical schools are inadequate; for experience has

demonstrated that this ideal cannot be achieved in a short space of time. That it has been and can be achieved in a period of from five to eight years under able teachers has been amply proven. The interesting and, to me, significant result of the second part of my questionnaire is that the great majority of surgical teachers apparently visualize this ideal and realize the time required for its achievement; for as I have noted, 75 per cent of all heads of surgical departments of medical schools who have had experience with graduate teaching advocate a five to eight years' course of instruction.

## SUMMARY

(1) Data upon the qualifications for admission to the method, duration, scope and recognition of graduate instruction of 59 recognized medical schools have been collected and studied. Data representing the opinions of teachers of surgery regarding graduate teaching also, have been collected and analyzed.

(2) Twenty of the 59 medical schools studied do not offer any kind of graduate instruction in surgery. This number represents 33.9 per cent of the total number of medical schools of which I have data and suggests the opportunities still possible of development in this direction.

(3) In the 39 medical schools which offer some form of graduate instruction, the qualifications for admission to advanced study are graduation from a recognized medical school in 14 and graduation from a Class A medical school plus an internship in a recognized hospital in 25.

(4) The Resident system, meaning by the term a period of residence in a teaching hospital in intimate contact with teachers, clinical material and laboratories, is almost universally used as a means whereby opportunities for acquiring an education in surgery are offered.

(5) The duration of courses of graduate instruction varies in our medical schools. Six schools offer a course less than three years in duration; 18, a course of three to four years in duration, of which the period is three years in eight and may be more than three years in ten; and 15 a course which is always five years in duration and frequently exceeds this period.

(6) The scope of instruction is usually fairly broad and informal in character. It includes general surgery and the specialties of urology, orthopedic surgery and gynecology. In the schools in which the shorter courses are given, training and experience in these subjects are necessarily limited as they are in the laboratories of surgical pathology and surgical research. Perhaps the striking differences between the shorter and longer courses are, in the latter, the increase in time given to clinical work in general surgery and its specialties, but particularly the time allotted to the laboratories of surgical pathology and surgical research and the emphasis placed upon individual responsibility for the care, including operative treatment, of patients as a means of developing character, surgical diagnosis, operative technic and surgical judgment.

(7) The recognition of advanced work in surgery by the faculties of University medical schools does not obtain in the majority. An advanced Uni-

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versity degree is not granted in 26 of the 39 schools under consideration and probably not in four; may be granted in nine schools. In these, degrees granted may be a Master of Science in Surgery, Bachelor of Science in Surgery, Doctor of Science in Surgery or Doctor of Philosophy. That the trend of opinion is toward the granting of advanced degrees is indicated by the fact that 28 surgical teachers favor an advanced University degree in recognition of the satisfactory completion of graduate work in surgery, two are not opposed to it but question its value, and ten are opposed to it, or think it unnecessary. Nineteen surgical teachers did not offer an opinion.

(8) The study as a whole would seem to indicate that the opinion of teachers of surgery regarding graduate teaching is in the process of crystallization. There is agreement as to the method of instruction and its scope. There appears to be, as judged by the expressed opinion of teachers of surgery, a growing realization of the need of a more prolonged period of education for the purpose of producing a higher type of surgeon. The fact that 75 per cent of the teachers of surgery believe, as a result of their experience, that five or more years of instruction are desirable while only 38 per cent now give that period of instruction, is evidence of the trend in this direction.

(9) The study is not to be interpreted as an effort on the part of its author, toward standardization of graduate teaching in our medical schools; for he is opposed to this idea. Teachers of surgery either have concluded or, in time, will conclude that a high type of surgeon is the objective of graduate teaching and have determined or will determine the period of time necessary to produce him. Within this block of time, teachers of surgery should remain free to carry out their ideas of surgical education just as they should, within reason, allow their graduate students to follow their natural bents.

(10) The study shows that, while satisfactory progress has been made in the development of advanced education in surgery in our medical schools, there still are lacking sufficient opportunities to meet the demands of men seeking a higher career in surgery and to meet the needs of the country in respect to trained surgeons. It would appear that our immediate problem is to discover, if possible, ways to meet this situation, by encouraging all Grade A medical schools to adopt graduate teaching as a part of their educational program, by presenting the possibility of the larger, qualified and at present non-teaching hospitals participating in this educational effort, or by some other means.

## OPPORTUNITIES FOR GRADUATE TEACHING OF SURGERY IN LARGER QUALIFIED HOSPITALS

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THE interest in the subject of graduate instruction in surgery is increasing year by year, as the demand for more thoroughly trained surgeons has increased in state and national organizations. Such specialties as obstetrics and gynecology, ophthalmology and otolaryngology, already have national organizations requiring several years of special training; and within the last year definite steps have been taken by the Advisory Board of Medical Specialties for the recognition of advanced training in general surgery. As a body of recognized and qualified surgeons we should consider the subject of graduate training in surgery, and should see to it that certain standards in this training be established. In addition we should be careful that the faults and penalties of standardization are not imposed upon us by outside organizations in the next few years.

Doctor Heuer has discussed the opportunities for graduate training in the University Clinic Hospitals where the tradition, training and purpose of the Surgical Service is not only the care of the patient, but also teaching and research. There are, however, a very large number of completely equipped and thoroughly qualified hospitals in all of our large cities where there is a splendid opportunity for carrying on graduate teaching in surgery of an advanced type, but in which no opportunity is offered and no effort made to supply an ever increasing demand for graduate work. By graduate work I mean training in actual clinical and operative work for surgeons who have completed their internship, but who desire to spend three to five years more of training before going into the practice of surgery. This does not apply to physicians who have had no surgical training, who have been in general practice and who for one reason or another desire to become surgeons in a period of a year or less.

A few of the postgraduate courses and fellowships offered in various parts of this country are in many ways carefully planned, and a review of the subjects of anatomy, physiology and pathology are adequately given; but they practically all lack the one essential, namely, the training in actual operative work in a graduated ascending scale, and in the giving of responsibility under supervision to the graduates taking such a course. The only place in which this type of training is given is in the hospital where the Resident or Fellowship system is in vogue, and where the scheme as outlined by Doctor Heuer has been in operation.

I wish to qualify the type of hospital and the character of training that are under discussion. Only thoroughly equipped hospitals, having (1) ade-

quate laboratory facilities, (2) free ward bed patients, (3) continuous services, and (4) recognized surgeons of real ability who are truly interested in teaching on the visiting staff, are considered as offering the opportunities for actual clinical and operative training. Such hospitals may or may not have medical school affiliations. If they have, so much the better. There are one or two large municipal hospitals in every large city and three or four others having large endowments with ample free bed services that could qualify for this type of training.

There are definite reasons why adequate opportunity for graduate training has not been offered by the qualified hospitals in this country up to the present time. This has to do with the history and tradition of the organization of the visiting staff and the internships in the hospitals in various parts of the country.

In the majority of the charity hospitals in the large cities the visiting staff on the surgical services for many years has been a fixed one, often arranged in four or six month services. In more recent years a Surgical Director has been appointed, with a large number of associate and assistant surgeons under him. As a rule the members of the visiting staff are in active practice, and in a number of the charity hospitals a considerable amount of the emergency work and the less major operating is done by a resident staff. If such resident surgeons are given the proper guidance and assistance their training is the type that fulfills the requirements of graduate teaching; for as a younger group, having had an internship and rotating through a period of three years of graduate training, they constitute an invaluable link between the internship and the permanently appointed but often frozen group of visiting surgeons.

In many hospitals, however, there is no intermediate group between the interns and the visiting staff. The interns, if given a large amount of operative work—as is the case in some cities, notably New York—are not experienced enough to benefit by it, and their term of service is too short to be of value to themselves or the surgical service.

In other hospitals, if the senior visiting surgeon is avid for operations and basks in the kudos of a large public operative clinic, the younger attending surgeons have to be content with the leftovers, and not many crumbs are left for any one of the grade of surgical resident or fellow.

In some cities a certain tradition has grown up which favors giving a large amount of the less major work to the house surgeon. In New York this has an interesting history. In the late '70's and early '80's, because of the lecture system and the lack of individual instruction in the medical schools, a system of quizzes developed which was designed originally to give individual students more detailed knowledge in anatomy and physiology, but which within a few years frankly became an extracurricular training class for hospital examinations. The men who stood high in a quiz were sure to get high rank in the hospital examinations at the end of their medical school course. It is interesting to note that William S. Halsted was one of the pioneers in quiz teaching at the College of Physicians and Surgeons, and at one time



before going to Baltimore he had some 75 men in his quiz. These quizzes accomplished a very much needed instruction at the time, but they subsequently created a very distinct prejudice against the Resident system in New York hospitals.

The competition for top quiz men on the part of the hospitals soon became keen, and it naturally resulted in more and more operative work being given to the good house surgeons as an inducement to attract the best quiz men. The younger visiting surgeons in giving away emergency and routine operations to the house surgeons were naturally more popular with the intern staff. A tradition was thus established which has had a distinctly bad effect in discouraging the development of surgical residents or surgical fellows in the charity hospitals of New York and other large cities. It does not require any great acumen to understand why a graduate group, intermediate between interns and junior visiting surgeons, is not popular when first introduced into a surgical service.

There is another reason why the idea of surgical residents or fellows is unpopular with many surgeons and in many hospitals. In the past, especially in some of the large university clinics, the surgical resident, during his indeterminate term of office, has been entirely too autocratic and domineering in his attitude towards all but his immediate chief; and in some instances he has antagonized both the visiting staff and interns alike against the whole Resident system.

There is a happy medium between the surgical staff with no intermediate group between interns and visiting staff, and the resident staff with an autocratic resident surgeon.

The surgical internship should be so arranged as to be a stepping stone for the able house surgeon to be advanced to an assistant resident or junior fellow. During the period of service as house surgeon the intern should be given a fair amount of the responsibility of the ward service and enough operative work under direct supervision of the visiting staff to determine his dexterity, his judgment, and his general fitness to continue in his surgical training as resident or fellow.

A group of three or four assistant residents or junior fellows, so chosen, may well spend a year in out-patient work in the mornings, with their afternoons free to work on some laboratory or clinical investigation in medical school or hospital. From this group the one best qualified should be advanced to a residency or senior fellowship, and for a period of two to three years should be given increasing operative work in major surgery, rotating through the main fields of extremity, thoracic and abdominal surgery, with subsequent training, if he desires it, in the specialties. This would mean a longer and higher curve of training than the typical saw tooth curve of an internship, and would provide a regular changing group of young, adequately trained surgeons intermediate between intern and visiting surgeon, stimulating investigative work and keeping both intern and visiting staff on their mettle.

It would do away to a large extent with the inertia of the sterile frozen

visiting staff, so common in our charity hospitals. This plan should not carry with it, however, the faults of some of the university clinics, where the major part of the operating as well as a good part of the teaching is done by a relatively inexperienced resident staff; for the plan as outlined insures a balanced division of the operative work between house surgeon, resident or senior fellow, and visiting surgeon, and demands that the assisting and teaching of the residents or fellows in major operative procedures be done by the visiting surgeons; also that the greater part of the instruction of undergraduates in the principles of surgery in university affiliated hospitals be done by the older visiting surgeons.

There are and there will continue to be strong objections to this plan on the part of the superintendents of hospitals because of the added expense of housing a group of four additional men on a surgical service. There are the natural objections of house surgeons and junior visiting surgeons to the proposal. But only such hospitals as have tried having a group of live, keen, carefully selected young surgeons receiving advanced training by rotating through the surgical service have any idea of the advantages to the hospital and to the great problem of meeting the steadily rising demand on the part of the public and the state registering boards for surgeons who are adequately trained and properly qualified not only in general surgery, but in the specialties as well.

More recently the definite steps taken by the Advisory Board for Medical Specialties indicate the conviction on the part of the various national societies that men should be qualified in general surgery just as they are in ophthalmology, otolaryngology, gynecology and obstetrics. The license to practice surgery has been carefully worked out in such countries as Denmark and Norway, and in the Canadian province of Alberta, where careful training over a long period of time is demanded as a prerequisite of the granting of a license to practice surgery.

The granting of a degree for advanced graduate work in surgery or in the surgical specialties is not an essential factor in the success of the plan as outlined. It is the quality and character of the training over a three to five year period that will determine the benefit to the graduate and to the hospital in which he gets his training. But the character of the training will definitely determine the demand for such training in the individual hospitals, and the rating of such hospitals by the qualifying boards.

If in teaching centers such hospitals have university affiliations the granting of a degree for a long term graduate training can be arranged advantageously, but it should be granted only to qualified candidates who have fulfilled all the requirements, including the submission of a thesis on work done during the three to five year period. If in the large cities several hospitals should offer such graduate training, it would be possible to conduct seminars in the several hospitals for all the graduates taking such training, so that they would see the work of more than one clinic and would have the advantage of an exchange of ideas. Combined clinics in "middle ground" diseases such as

chest, thyroid, spleen, gastro-intestinal or vascular disturbances or tumors, in which internists, surgeons, pathologists and radiotherapists study patients before and after such therapy as has been agreed upon is completed—such clinics offer the very finest type of instruction for graduate students in both medicine and surgery. We find at the Vanderbilt Clinic that the combined clinics are the most sought after and appreciated by our surgical fellows. In fact our senior fellows have had a very real part in developing these combined clinics to their present high standard of usefulness, and have kept the senior members of the staff on their mettle to keep up the pace set by the medical and surgical fellows working in these clinics.

## SUMMARY

To sum up the essentials for the adequate training of the graduate in surgery over a three to five year period after internship:

(1) Hospitals having adequate laboratory facilities, ward services for charity patients and a staff of unselfish surgeons of recognized ability and character, who are interested in the advanced training of surgeons after the intern period.

(2) A graded scheme of instruction in preoperative, operative and post-operative care of patients with an increasing amount of responsibility and operative work, under supervision of the senior surgeons, over a period of three to five years.

(3) Seminar instruction in combined clinics in the out-patient departments of the several hospitals in the larger cities in which graduate training is being given. These seminars should be held for the combined groups of graduates in the several hospitals of the individual cities.

(4) The granting of a degree for qualified graduates after a period of three to five years of training is not an essential feature of the proposed scheme of graduate training. For hospitals having university affiliations there are advantages in granting a degree provided those receiving the degree are qualified by adequate examination, and provided they present a thesis as evidence of original work during the period of training. The degree should be rigidly reserved for properly qualified candidates. Its value will depend upon the quality and character of the work done in the hospital and university granting the degree.

The responsibility of the representative surgeons of this country to meet the ever increasing demand for more advanced training in operative surgery and in the care of surgical patients must be met not only by the surgeons working in university clinics, but also by the surgeons in the thoroughly qualified hospitals in the larger cities. The old type of postgraduate teaching from the benches of the amphitheater is a thing of the past. What is demanded and expected now is honest, careful, practical training of qualified men who desire to take a long term in their training of surgery.

In conclusion, we wish to emphasize that such graduate work as has been proposed in this paper cannot be and should not be standardized. A three

year experience in one hospital with one group might easily be more comprehensive than a five year training in another clinic. But there must be definite standards which should apply to candidates for the training and to those teaching in the clinic and hospital in which the training is given.

DISCUSSION.—DR. ARTHUR DEAN BEVAN (Chicago, Ill.).—The study and the teaching of surgery has been for most of us our life's work. There is only one way to learn surgery and that is from a master surgeon. This fact is as old as Hippocrates. In the Hippocratic Oath the surgeon pledges himself to teach the children of his master "Of Him who taught me the art."

The great schools of medicine and surgery have been founded by great physicians and surgeons: Hippocrates, Galen, Sydenham, Langenbeck, Claude Bernard, Virchow, Billroth, Osler; and may I mention two who are still with us today, William J. Mayo and Harvey Cushing. The apprentice learns from the master workman. The great assets of a medical school are the great teachers it possesses, not the buildings or the endowment.

The teaching and the study of surgery are very simple things. The eager pupil, after acquiring a good knowledge in the fundamental medical sciences, learns surgery by watching and assisting the master surgeon in his actual work of handling his patients, in the history taking, the examination of the patient, the laboratory work that is essential in the case, the treatment or operation which is indicated; this is done in the teaching clinic in the hospital and the dispensary.

In this teaching the essential scientific knowledge should be taught in the simplest possible way, in the most commonsense way, in the most judicial way. I have been much impressed by Sir Thomas Lewis' book on the heart. Here is a book written by a great scientific student, a man who has added much to this special field of knowledge by years of research, and yet he tells his story in such a simple, commonsense way that even a surgeon can understand. We who are teaching surgery can well take a lesson in teaching from this book.

In teaching surgery we must devote at least half our time to teaching of the anatomy, the physiology, the pathology and the general principles of surgery involved in the problem under discussion. I have found that, no matter how well trained the students have been in these daughter sciences of medicine before they come to us, that it is absolutely essential to review these underlying sciences in each surgical case presented in the clinic. This is the only way of mastering these fundamental sciences. Surgery should be taught in the medical school as a well balanced whole. The entire field of surgery should be taught by men well grounded in general surgery. There should be no independent courses taught by surgical specialists. Men who are broadly trained in general surgery and devoting most of their time, or all of their time, to some special field can be utilized in the teaching of special subjects, provided that it is made to fit into a well rounded and well balanced whole. It is not safe, however, to give these men the teaching control in these special fields because they attempt to teach their subjects as though they were making specialists of the undergraduate students and as though it was an independent subject and not as it should be taught, as a part of general surgery.

Possibly, I can make my conception of this subject clearer by outlining the plan which we have developed in our own work. The teaching clinics conducted by the Chief and his associates are the backbone of the surgical course. These clinics cover the entire field of surgery. The entire subject is divided into three parts: (1) The head, neck and thorax; (2) the abdomen; (3) the



extremities. Three months of each year are devoted to each of these divisions. In the study of the head, neck and thorax, the general surgeon giving the course asks the specialists in neurosurgery, oral surgery and thoracic surgery to give to the undergraduates a few special clinics, giving in a simple way a summary of these special fields; no attempt should be made to cover them completely. In the same way the course on general abdominal surgery should be supplemented by a specialist in genito-urinary surgery, and the course on the extremities be supplemented by a few clinics given by an orthopedic specialist.

The proper place to teach the surgical specialties is in the postgraduate work for those who are preparing themselves to enter such specialties. We have made a mistake in this country in splitting up general surgery into too many divisions. Before it is too late these subdivisions should be brought back into general surgery, at least as far as the teaching of undergraduates is concerned. This must be done in the interests of the science of medicine, the medical profession and the public.

Half baked commercial specialism is today a great menace both to the profession and the public; there should be no hesitation in pointing this out and in correcting it. Many of these so called specialists are no more fit to take charge of important clinical problems than are laboratory technicians. Outside of their very limited field they are lost and their patients suffer. The only safe specialist in surgery is the man who is first of all well trained in general surgery, who then develops into a specialist by devoting special work to some particular field.

Every general surgeon should cultivate some special field in surgery so thoroughly that he becomes a recognized authority in that field. If later he is forced to limit his work, all well and good. Such men are the best specialists. As an example, in each well organized surgical department, there should be one or more men doing outstanding work in bone and joint, rectal and colon, genito-urinary, thoracic, neurologic, plastic and abdominal surgery. This is the only way of developing sound and scientific surgical specialists. The young men who receive their entire surgical training in the clinic of a specialist whose work is limited to a narrow field of the patient's anatomy, a single organ or group of organs, are greatly handicapped. They become, as a rule, mere technicians in that narrow field; they do not see beyond it; they are often a menace to the patients who fall into their hands.

Medical students must receive instruction from men who are thoroughly trained to give it. They must be taught as a successful coach handles a football team. The conception that you can give a medical student a cadaver and a book and tell him to learn anatomy, or that you can assign him a patient, give him a book and a blank history sheet, and tell him to learn clinical medicine is the daydream of instructors in medical schools who have learned their medicine as salaried teachers in biologic laboratories and not as clinicians whose lives have been spent largely on the firing line of practice with patients and in teaching clinical medicine.

Modern surgery is the application of anatomy, physiology, pharmacology and pathology to the study of the etiology, diagnosis and treatment of surgical conditions. It is well, early in the student's clinical work, to saturate him with the conception that he must for the rest of his life study the sciences of anatomy, physiology and pathology, as well as the sciences of diagnosis and treatment. The value of experience with a large group of well studied and well handled cases can not be overestimated; such experience becomes the surgeon's greatest asset.

The surgeon must be primarily a well trained practitioner of medicine. The



great surgical teachers have always emphasized that fact—Billroth, Bier, Senn and Cushing. The modern surgeon who is not thoroughly trained in general medical diagnosis and therapy and who does not keep abreast with the increasing knowledge in general medicine and who depends on his medical colleagues for the diagnosis in his cases degenerates often into a technician. The modern surgeon must be quite as well prepared to make as complete and exhaustive examination and as definite a diagnosis and differential diagnosis of the cases that come to him as his medical colleagues. That is true, and most important, because the majority of the cases seen by the surgeon are not operative cases at all.

Harvey Cushing is a good example of a well trained general surgeon, gradually developing a surgical specialty to a point where he becomes a great authority in it and at the same time he continues his contact with general medical knowledge until he becomes not only a neurosurgeon, but also a broadly trained physician and a recognized authority in neurology.

May I apply these thoughts to the future development of the American Surgical Association and to the development of the men who compose it? Let us make of the American Surgical Association a Society which will cover in its work and membership the entire field of surgery; let us take into the American Surgical Association the men who have had a broad training in general surgery and who have become leaders in all the special fields of surgery; let every member of the Society develop himself primarily as a general surgeon and at the same time cultivate some special field until he becomes a recognized master of that field; let every member realize that primarily he is a physician and keep in training so that he remains a great physician; let us recognize and emphasize the fact that surgery is a profession and not a trade or a business.

The surgeon occupies a most important place in the community. He is often the court of last resort. The health and the life of the patient are often in his hands and depend on his judicial decision and efficient management. We must see to it that the men who enter the ranks of the qualified surgeons of this country are not only men of scientific training, but, what is equally or more important, that they are men of character, culture and refinement; men who accept a high code of morals which controls them in their lives and professional work; men who never commercialize their profession; men who accept the spirit of the Hippocratic Oath and the code of ethics; men who practice the Golden Rule.

The intern year should be regarded as part of the undergraduate course. The intern should not be permitted to do independent operating in any hospital. He should be still regarded as an undergraduate student, and I think the proper development of an organization in surgery should be carried out not from the time period, but just as it actually has been carried out in the best teaching clinics of the world. After his intern year the young man training to be a surgeon should become house surgeon, then assistant and later associate in the hospital and in the clinic.

It is not a question of being there three years or five years. The training of a surgeon is the work of a lifetime; it means that the young man who aspires to become a teacher of surgery must mount one step after the other—intern, house surgeon, assistant instructor, associate instructor, instructor, assistant professor, associate, and finally Professor of Surgery.

We owe a great debt to the gentlemen who have prepared this discussion, but I think we should simplify very much the entire course.

DR. DAVID CHEEVER (Boston, Mass.).—I want to second what Doctor

Bevan has said about the obligation we are under to these three enthusiastic and able men who have presented such excellent reviews of this subject. Really, much the easiest thing for me to do would be simply to say Amen to what they have said, with which I agree almost entirely.

I am entirely in accord with Doctor Cutler's characterization of the principles of surgery, the institutes of surgery, as the study of prevention of pain, hemorrhage and sepsis, and I would add to that perhaps the prevention of deformity and promotion of repair. I am strongly in favor, also, of his insistence, as are Doctor Whipple and Doctor Heuer, on the study of anesthesia in the undergraduate curriculum. I think it is absolutely necessary. I think anatomy ought to be taught by men who know the significance of anatomy, not by Doctors of Philosophy who have never seen a sick patient.

I should like also to say a word about pedagogy. I do not think we pay enough attention in our undergraduate work to the encouragement of teachers who are good teachers. I think that pedagogy is a very important thing; whether it can be learned or not, I do not know. Certainly, some men tend to be born with it and some men, no doubt, develop it. To my mind, it is better that a first class man should lecture or teach 50 men than that a second class man should teach ten men.

Of course, the resident system is perhaps the particular point which is novel to some of us and I rather think we have to shed a tear upon the bier, as it were, of the old-fashioned intern system. Yet, as I look around at this group, I see some of the most prominent surgeons who were developed in that system and developed themselves from that system, and I think that the old internship such as it existed at the Massachusetts General Hospital in the old days, of two years, developed a very splendid type of man who was able, as I say, to develop himself as far as he wanted from that point.

I think it is no, or at least but a slight, disparagement, but an inevitable, regrettable feature of the too highly developed residence system that the old intern system has been somewhat emasculated.

We are building a pyramid which consists of different strata, and we are trying to train a man to reach the top. Of course, all success in life is a pyramid. Ultimately, we find the successful man at the top, but our education under the residence system tends to make men feel that they have to go through these successive steps; those of the undergraduate, the intern, the assistant resident and resident and super-resident, *etc.*

We are training a group of men who are so highly trained they get ideas that they must attain to that pinnacle before they stop being educated, and it seems to me we ought to encourage some of those men, certainly a group of them. There are not places enough for them all to reach the top and it is very painful to see these ambitious young men feeling they have to reach that ultimate pinnacle of surgical education before they can start in practice. Some of those men, I think, ought to be counseled to drop off at various points and enter the rough and tumble of practice. Just how it can be done, I do not know.

One sentence of Doctor Heuer's paper might be considered a little bit cynically. He speaks of the ideally trained surgeon as a young man who has fulfilled the postulates which he describes, and all of which are highly desirable. A simple computation will reveal the fact that the young man is nearly 35 years of age when he has fulfilled those postulates. He has reached at least half of the psalmist's three score years and ten, and he has reached more than the half of the average age at which he will be forced to retire from his surgical work.

He ought, I suppose, to take Osler's advice to the young man to put his

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passions upon ice and wait, but perhaps he might after all have the normal instincts of mankind, to establish a family. We might again turn to Osler and say that life ends at 40.

I am rather inclined still to turn to another distinguished man and say that perhaps at 40, having attained the perfection of surgical education, he will then belong to that sterile, frozen group of visiting surgeons described by Doctor Whipple. There is no such thing as too much education in surgery and I am in favor of the highest education we can get, but let us use common sense.

DR. THOMAS G. ORR (Kansas City, Kans.)—Our aim in this discussion is to formulate in our own minds the practical needs of surgery and present ways and means to improve surgery in general and especially in this country. While the thought must assuredly come before the act, theorizing and preaching without practical application will accomplish little. The crying need for more surgeons and fewer operators must be evident to all.

Without a revolutionary change in our medical practice laws the only hope for better surgery in the United States is proper education of young surgeons and education of the public that only specially trained surgeons are qualified to do major surgery. Surgery is being taken to the patient more and more by the construction of small community and private hospitals. Patients prefer to be operated upon near their homes and are likely to accept service in inadequately equipped hospitals for this reason. I have known civic pride and a sense of civic duty to influence patients to remain in their own community hospital for surgical treatment. The only answer to this situation is to place better trained young surgeons with better trained surgical nursing supervisors in the smaller hospitals throughout the country.

After listening to this symposium one may conclude that a minimum of three years postgraduate surgical training in addition to the intern year is necessary before a young surgeon can render adequate service to the public. It is further concluded that additional years of training are desirable, especially if men are being trained for teaching and investigative work. In a service of three to eight years the graduate student in surgery is brought in daily contact with all phases of training necessary to equip him to do operative surgery safely. In addition to learning diagnosis, the indications for surgery, surgical pathology and physiology, pre- and postoperative treatment and operative treatment and operative technic, he cannot fail to acquire to some extent the spirit of investigation, and, by no means least, a sense of surgical honor. Equipped with such training a man would rarely fail to raise the standard of surgery in his community.

I do not believe that there is any justifiable complaint against the quality of surgery being done in university and private clinics where years of postgraduate work are offered. The urgent need of improvement is in the general private practice of surgery where now exist only a sprinkling of surgeons and a deluge of operators.

I question if we, as surgical teachers, are making our influence felt as it should be felt for the betterment of surgery. In addition to thorough training perhaps more thought should be given to the placing of competent young general surgeons in strategic positions in our own states and communities. This to my mind is one of the first steps toward better surgery in private practice. Young men who have lived in an atmosphere of surgical respectability from three to eight years will undoubtedly discourage not only inefficiency but the other two major evils, useless operations and fee splitting. Some plan by which the stamp of approval by certification can be placed upon

qualified young surgeons, which the general profession and public will recognize, seems to be indicated at this time.

DR. WILLIAM E. GALLIE (Toronto, Canada).—The introduction of a symposium on the Education of the Surgeon into our program indicates that at last we are alive to the seriousness of the situation in regard to the practice of surgery as it exists throughout this country.

Doctor Cutler has shown that our medical schools make no pretense toward teaching this practice of surgery to undergraduates. Yet each school grants a degree which publicly declares that the graduate is qualified to practice medicine and surgery, and some schools even go so far as to grant, along with the M.D., this special degree of C.M. The result is that the great mass of the surgery is being done by men who have been inadequately trained.

To overcome this Doctor Heuer and Doctor Whipple suggest that proper opportunities be provided in our medical schools and large non-teaching hospitals for postgraduate training of surgeons. This is an admirable suggestion but it will be ineffective or only very slowly effective unless the general public and more particularly the family practitioner is brought to understand that special surgical training is essential. Restrictive legislation of some sort must be introduced which will prevent inadequately trained men from performing major operations. Doctor Heuer's plan of postgraduate teaching appears to me to be excellent for the young surgeon who proposes to become a teacher of surgery. The prolonged period of training suggested, however, seems to me to be altogether too long for preparation for ordinary practice. There should be two courses provided, one for the teacher, which includes a prolonged residence in a hospital, opportunities for surgical research and perhaps a tour abroad, and one for the ordinary practitioner of surgery.

Both Doctor Heuer and Doctor Whipple have indicated the solution of the problem of the proper education of the surgeon when they suggest that our large hospitals constitute themselves as postgraduate schools whose students are the surgical interns. It seems to me that if we could get away from the idea that the surgical intern is a servant who does the daily work of the hospital for a year or two and then disappears, and substitutes for it the notion that he is a graduate student who has come to learn to be a surgeon, a long step will have been taken in the right direction. This would mean that when the intern is appointed it will not be for a year or more in somebody's service, but it will mean that after due consideration and adequate preparation he is committed to a surgical career and has been admitted to a balanced course which includes sufficient time in clinical medicine, surgical pathology, general surgery, gynecology, urology, orthopedics, *etc.*, and that when he departs from the hospital it will be with the guarantee of his teachers that he is qualified to practice surgery.

DR. DEAN LEWIS (Baltimore, Md.).—I have been greatly interested in Doctor Cutler's presentation of the subject of undergraduate teaching—the time to be devoted to each subject, the arrangement of the material and the advantages and disadvantages of lectures, which have been frequently discussed during the past few years.

The most important matter of all is the student material. If the students are mentally equipped and are of the right kind, it matters little about the rest. I have talked with surgical teachers frequently about the quality of the student body. It seems to be quite generally conceded that in a class of 70, from 15 to 20 students will be of superior quality. No teaching is required when these are considered. They require some direction but will work independently. They are hampered rather than helped by too much teaching.



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In this class will be from five to ten who do not do well. These students, often apparently trying their best, do not seem suited for the study of medicine. I believe that these students should be kindly advised at the end of the first year that they should discontinue the study of medicine. A student who might have been saved may be dropped at times but the number so lost to medicine will be small.

Between the first and the last groups fall the large number who have to be watched carefully, guided along their course and stimulated to increased endeavor.

In educating this group, some discipline must be employed. There is a tendency in modern education for the student to neglect the subjects which are difficult. At times he is abetted in this by the instructor, but I believe the student should be stimulated to overcome such difficulties, for such training gives confidence and a will to do.

The quality of the material is the most important thing in maintaining a high quality of medical care and simplifying medical teaching.

DR. EUGENE H. POOL (New York).—I have been very much interested in the problem of graduate surgical teaching for some years, and have been in a position to watch, as an impartial observer, these two methods in operation. I think the problem has not yet been solved. Yet Doctor Whipple's method has much in it that appeals to me.

His plan continues the old method of the intern. Under it a man who goes on as an intern gets something worthwhile throughout the whole period of two years, including operative training at the end. Therefore no time is wasted. A selected group continue as fellows. The only objection to the system is that not enough men can have the opportunity of a fellowship.

The other method, based on residents, produces from a large center two trained men every 18 months. That is not a drop in the bucket towards supplying the needs for surgeons through the country. Moreover, as our President stated, "the surgeon needs skill and judgment," but the greater of these is judgment, and the five years cannot give that.

The residents become skilful technicians, but at what price? A number of aspirants start. At the end of one year a considerable proportion are lopped off. This is unjust, and not economical, for these men have wasted a year, as far as surgical training goes. A number more are dropped off at the end of two years, again without surgical training, and again some, I believe, at the end of three years.

And what is the method of progress towards a Residency? Such is the nature of the competition that to get upstairs one must kick his colleague downstairs. One must play up to the men who have the appointments to make. This is not a character builder.

Doctor Cutler, I think, omitted only one thing in his admirable summary of undergraduate teaching, and that is the importance, to which Doctor Cheever has referred, of personal contacts. Who of us is not better for and does not revere the memories of close contacts with our Oslers, Halsteds, Bulls and McBurneys? The undergraduate now, I think, fails to get this stimulus and inspiration.

DR. JOHN S. RODMAN (Philadelphia, Pa.).—It does not seem to me to matter which method, of those which have been discussed, is finally chosen of educating surgeons. I think most of us will agree that Doctor Heuer's way is an excellent one, but I am afraid in a country of 130,000,000 people, the facilities are not going to keep up with the needs in that respect, and



that most of us are going to have to see surgeons grow up by the apprenticeship system, which I think most of the members of this Association have done.

If that is the case, then it seems to me the most essential thing that we have to have is some sort of a certifying body that will honestly certify to one's qualifications to practice surgery.

Doctor Whipple spoke of the Advisory Board of Medical Specialists and as a member of that Board I have been very much concerned and interested in the development of a standard for qualification that all the specialty boards now can follow.

I do not know whether or not the members of this Association know that there are now some seven actually organized and operating qualifying boards in certain specialties; more limited fields of specialization, of course, than general surgery, such as ophthalmology, otolaryngology, obstetrics and gynecology, *etc.*

I have had an opportunity to attend some of the examinations conducted by the ophthalmologists and otolaryngologists, and know that they are making a very determined effort to honestly qualify men in their special fields and to make them demonstrate that qualification before they are given a certificate to prove they are so qualified.

I realize for the general surgical field, of course, that to establish a qualifying board is a much more complicated matter. Whether it is of particular concern to this body or not, I am not sure, but I think we should at least take an interest in it. I think that some suggestion as to how this shall be done is going to come from other surgical organizations of the country. Perhaps the Surgical Section of the American Medical Association, perhaps the American College of Surgeons might consider this matter. I hope this Association, which we all here believe is the representative body of the United States, through a representative, if there be a Board in general surgery finally created, will have something to say about what qualifications may be set up for the general run of surgeons who are going to have to supply the needs of the country, admitting that those who will qualify through Doctor Heuers' method will be among the leaders of the profession.

DR. EVARTS A. GRAHAM (St. Louis, Mo.).—I think this is a momentous occasion for the American Surgical Association. Doctor Bevan started the ball rolling in this Association by calling attention in a very forceful way to many of the matters which have been brought up this morning.

I have been also particularly pleased with the remarks of our President and with the three papers. My principal reason for rising to take part in the discussion is to express my hope that now something will be done about the whole matter. The remarks made this morning, although excellent, are really only a continuation of the discussion that has been going on for many years among those of us who are teachers of surgery. Yet nothing has ever come of it in regard to the most important matter of establishing proper standards of qualification of those permitted to practice surgery.

There are essentially three organizations that might be interested, as Doctor Rodman has mentioned: The American Medical Association with its Surgical Section; the American College of Surgeons; and this organization, which very largely is composed of the teachers of surgery. It seems to me it is a very proper function of this organization, which very largely is composed of teachers of surgery, to carry on the interest in this work.

I feel that the American College of Surgeons' interests lie in perhaps a slightly different direction. At least, they have not shown much tendency to

interest themselves actually in the education of the surgeon, and, therefore, I am compelled to assume that probably their interests lie in other directions.

We, however, are a group of teachers of surgery and it seems to me that it is our duty and responsibility to take an active part in doing something about the training of the surgeon. I intend, therefore, Mr. President, at the end of my remarks to propose a motion unless I shall be out of order. But before I come to that motion, I should like to say that I am struck by the fact that there are certain serious defects in our approach to this problem which have not been touched upon.

Every speaker has mentioned the unsatisfactory state of affairs which permits a medical student after licensure by the state, to go out and perform any sort of operation which he wishes to undertake. All have mentioned also the fact that students nowadays go into a hospital for an internship, get exposed a little to surgery, and scatter to the four corners of the compass to carry out what they have learned.

Aren't these two factors chiefly responsible, gentlemen, for the large amount of poor surgery that is being done all over the country? Is there any good reason that can be offered for assuming that a man who has just graduated in the lower ten in his class, we will say, one of those to whom Doctor Lewis referred, has any right to practice surgery merely because he has had an internship which has exposed him perhaps to six or eight weeks of surgery? As a matter of fact is it not possible that such an internship may be a source of more harm than good? Is not an enthusiastic young man likely to overestimate the value of such a training and to develop a false sense of security, especially when such a rotating internship is acceptable to the American College of Surgeons, is apparently recommended by the American Medical Association, and is given an official recognition as a satisfactory sort of training by several state boards of health?

These are very fundamental defects. It seems to me that an examination into this whole question cannot possibly exclude an inquiry into what constitutes a suitable internship as a preliminary basis for a further surgical training. Is it not time to state frankly that an internship which permits an experience of only two or three months in surgery is not suitable and not acceptable?

I shall, therefore, Mr. President, propose that you, sir, appoint a standing committee of this Association to report next year at our meeting on a continuance of study of the question of the proper qualifications of a surgeon, in order that something may be done about it, instead of merely a reiteration of discussion.

DR. ROY D. McCLURE (Detroit, Mich.).—We have recently made a study in Michigan for the State Medical Society of the necessity for postgraduate teaching in Michigan. I would like to bring to your attention this postgraduate medical education pamphlet, published by the Michigan State Medical Society last year, reporting this study. We sent out examination questions to 1,000 doctors and had a large number voluntarily answered, giving us a fair idea of the present state of knowledge of students of the classes of 1910, 1920 and 1930. In this way we got some idea of the necessity for further postgraduate education.

As to the training of a surgeon, there can be no doubt there is great need for more better trained surgeons, not more surgeons but more surgeons who have had broader training. Anyone who has gone into the study of appendicitis mortality alone within recent years is simply appalled at the difference in postoperative death rates in the different hospitals. I know of one hospital

where the death rate is  $16\frac{1}{2}$  per cent, as compared to 4 to 6 per cent in relatively nearby hospitals. This comes about because every man operates for appendicitis regardless of the fact that he has had no adequate training for practicing surgery. Until this state of affairs is corrected we cannot expect improvement.

I feel, as Doctor Whipple said, we should not have standards of surgery forced upon us by legislation but corrective measures should come from within, and we, ourselves, should take the first step to improve the surgeon by providing five year training periods in adequately staffed hospitals. This will, of course, necessitate the coöperation and reorganization of many non-teaching hospitals, but I believe with the proper approach that this coöperation can be obtained and that it will lead to great benefit to the surgical staff as well as to the hospital.

DR. HUGH CABOT (Rochester, Minn.).—We hear from the seats of the alleged-to-be-mighty that there are too many specialists. It has even gotten into the papers. This statement seems to me so violently untrue that I venture to state the case in opposition.

There are not too many specialists in any field. There are altogether too many alleged specialists, people whose only evidence for specialization is their willingness to admit it.

If we should today set up a standard such as that proposed by Doctor Heuer, we should, I believe, be entirely unable to educate in any such way the number of surgeons which this country really requires. I think the crux of this matter is that there are today available, as Doctor Whipple has suggested, hospital organizations which can be used, if certain alterations are made, for satisfactory graduate education. They are not now being used. If we should by fiat decide that nobody should be allowed to practice surgery who had not had what we believe to be an adequate training such as proposed by Doctor Heuer and Doctor Whipple, we should be utterly unable to train those people in a satisfactory way.

We should like to believe that we could depend upon university organizations and upon the affiliated hospitals. Of course this is quite out of the question. We must draw into this picture a lot of hospitals now not doing proper teaching, not much concerned with anything more than the sending forth of alleged surgeons who lack proper qualifications and who must learn their surgery largely by trial and error.

I believe that this body probably could do more than any other to crystallize opinion in that direction, and lead toward the setting up of the proper organizations for teaching. They do not today exist, and we are required to see that they do exist before we lay down fiats as to what ought to be done.

I am interested in the awarding of advance degrees. I think them very desirable, but certainly they cannot be required. They do, however, tend to bring the whole problem under the purview of the university, where I think education in all fields ultimately belongs. I believe we should, as far as possible, encourage the men who are taking five or more years in preparation to become candidates for a degree where their affiliations are such that it is possible. That we cannot force it is obvious, but I believe we should encourage it. I think, in fact, we have not encouraged it sufficiently.

The crux of what I want to say is that we now have a restless mass of potential instructors perfectly capable of teaching surgeons as we think they ought to be taught. They are not organized, and I think we can do a good deal to help in their organization.

## HIPPOCRATIC SURGERY

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IT IS an interesting consideration regarding the continuity of medical thought, and perhaps for us a fortunate one, that of the two medical writers on Greek medicine, the one, Hippocrates, gives us an epitome of medical and surgical science at the very height of the ancient Greek civilization, and the other, Galen, sums it up at the end, within a few centuries of the fall of the Roman empire. In literature, art, and science, after Hippocrates began the gradual decline which, arrested though it was by many brilliant interruptions, finally ended in the chaos of the early Middle Ages; but in medicine we may say that, once established on the principles of humanity and common sense which Hippocrates established, its progress was sure and steady. Yet Galen summed it all up in his voluminous, controversial, often difficult and exasperating, but after all, brilliant, keen, and invaluable summary. During the 600 years between Hippocrates and Galen, there stand out the names of many real contributors to the science and art of medicine. Praxagoras of the school of Cos, Erasistratus and Herophilus, the anatomists of the school of Alexandria, who were the first to systematically dissect the human body, and contributed so much to our knowledge of the circulation and of the nervous system, and many others who were born, worked, and died in the interval between Hippocrates and Galen. Their writings have gone from the face of the earth, and all we know of them comes from the synopsis and quotations made by the great Galen. In spite of all his faults, we cannot but be thankful for his life, his work, even his contentious spirit, which led him in his argumentative style to quote so freely, in order to compare or refute their statements, from authors whose works have been blotted out by the hand of time.

Hippocrates, the great, the admirable, the divine, as Galen repeatedly calls him, looms in the skyline of the distant past; like a mountain, half hidden by mists and clouds, we recognize his greatness, we know little of his life. But apparently he never signed his treatises, and we have in memory of him three large volumes, some of them written with a lofty moral purpose, like the oath, and some of them showing his greatness, because pervaded with that common sense, which as Galen shrewdly remarks, is in spite of its name so rare that few people manifest it in the affairs of daily life.

It was the custom in his day to indulge in short and pithy sayings called "aphorisms," or in modern lingo "wise cracks," as shown by the reputation rightly or wrongly won by the "seven wise men" of ancient Greece by just such sayings. We have a book of several hundred of them, a credit to the great Hippocrates, beginning with the famous "Art is Long, Life is



Short," *etc.*, which is the best of all, and ending with its close rival, "What medicine will not cure, the knife will cure; what the knife will not cure, the cautery will cure; what the cautery will not cure, may be considered incurable." The long list between these two contains many which it is hard to believe were not interpolated by subsequent writers and commentators. Certain of Hippocrates' works, Prognosis, Diet in Acute Disease, Fractures, Dislocations, *etc.*, are written with a common sense and authority that mark them as the works of a truly great master. Others were plainly written by writers belonging to different schools of medicine though perhaps some of them were the pupils and successors of the great Hippocrates. Jones, who translated his works for the Loeb Edition, regards them as a part of the library of the medical school at Cos. The principal treatises are available in adequate translation and comment by Adams, Littre and others.

In general, if you compare the works of ancient medical authors on surgery with those on medicine, the former are characterized by greater clearness and lucidity. In surgery the problems presented are immediate and urgent, and require above all common sense and mechanical skill, swiftness, and coöperation between the hand and brain, and results for better and worse were, and had to be, quickly evident. What were they to do for the so called medical cases? Watch their course, care for the diet, and, as Hippocrates said, assist nature in her efforts to cure the patient. Having no chemistry, is it any wonder that they employed that great complex of philosophy, imagination and astrology called the doctrine of the humors, to explain the ills to which human flesh is heir? They had to have something, and they argued for this system so convincingly that everyone believed them for 2,000 years. And occasionally Galen argues so well for it that I almost believe him myself. I certainly find it as clear as modern medical chemistry, which, after all, may in a thousand years or so be on the top shelf with the works of Galen.

Since they had to do surgery, and the mechanics of surgery are so simple as compared with the chemistry of medicine, it is interesting to compare some of their surgical procedures with the present day. I am going to try to give you a brief account of what they thought about surgery, not included in the translations of the great works which you may read in the excellent translations of Adams and of Jones, but some of the minor treatises.

I am going to begin not with surgery, but with an account of the first experiment on an animal that I have found in literature. As all the writings of the Hippocratic collection may be dated not later than the fourth century, it may be dated no later than that. Now you should remember that the writings of the early poets were taken seriously by the ancient Greeks. Their old and new Testament may be said to have been the works of Homer or Hesiod, with their fantastic description of the gods and of natural phenomena. Now an early poet, Alcaeus of Lesbos, had written a poem in the dog days beginning, "Moisten your lungs with wine, for the dog star



risers again," for which reason or some other the ancients and even Plato concluded that the fluid nourishment went down the windpipe, and in some mysterious manner tunneled from the lungs to the bladder, where the surplus was eliminated, while only the solid food went down the esophagus into the stomach. Then someone discovered the epiglottis, which would plainly prevent the liquid getting into the trachea. However, the poet and the philosopher could not be quite wrong, they said, enough fluid must get under the epiglottis to properly moisten the lungs. It was to prove this that the experiment under discussion was advised. It occurs as a digression in the quaint treatise on "The Heart." I give it in as close an approximation as I can make to the writer's own words.

HIPPOCRATES DE CORDI (*Kuhn, vol. 1, p. 485*).—"The heart is pyramidal in shape, in color quite red. It is surrounded by a smooth capsule. In the capsule is a little fluid resembling urine, so that evidently the heart moves about inside this capsule. The reason for this is that the heart, with this protection, may be unimpeded in health and growth. It has just enough moisture to prevent it from becoming overheated. This fluid the heart absorbs and turns into serum. It takes it in and expends it continuously, receiving first from the lungs the fluid which we drink. The most of the fluid we drink goes into the stomach, because the esophagus is like a funnel and receives the most of the fluid, and the food ingested. Some of the fluid gets into the pharynx, being sucked in as from a nipple, about as much as can get in without being noticed as the main stream goes by. For the epiglottis is a tightly fitting cover and will not let in any more fluid than this. This may be proved if you will dye some water blue or red, and give it to a thirsty animal to drink, preferably to a hog. For this animal is neither a lover of beauty, nor neat in its habits. Then cut its throat while it is still drinking, and you will find this stained by the colored fluid. This operation, however, cannot be properly performed by everybody. There is no doubt about the fluid, then, that the human windpipe takes in some of it. But, you may answer, how is it that if a lot of fluid gets in it produces severe coughing and choking. For this reason, I reply, it is carried in the opposite direction to the expired air. For the little fluid that gets through the crack under the epiglottis does not interfere with the expiration of the air, but runs along the inner wall of the trachea, so that the moisture smooths the way for the passage of the air. This moisture is drawn out from the lung in turn, together with the expired air. The air, which is a means of producing health, the lung has to expel by the same route by which it took it in. Some of the moisture it absorbs into its enveloping membrane (the pleura) and some it allows to escape with the air. In the same way the palate separates the air from the moisture during expiration. The air has to be expired for the excellent reason that these things are not a form of nourishment suited to human nature. For how can raw wind and water nourish a man? No, they would be more likely to increase any disease already present. But to return to our description of the heart."

I have a great liking, as far as I can, to find out exactly what the ancient writers said on surgical subjects. Comment and summary are good, but let us see what they actually said. In a book entitled "Diseases" in the Hippocratic collection I found the following description of an operation for

empyema, which throws much light on the ancient methods of recognizing the presence of pus in the pleura and getting rid of it when found. It is a part of a discussion of abscess in the lungs and pleura, evidently following pneumonia.

HIPPOCRATES, (*Kuhn, Disease II, vol. 2, pp. 285*).—"Another Disease.—When the duration of the disease becomes longer, the fever is severe and the cough is increasing, and the side is painful, and he cannot bear to lie upon the well side, but has to lie on the side of the disease, then the feet swell, and the hollows of the eyes. When the fifteenth day after the rupture arrives give him a profuse bath of hot water, sit him in a firm seat that he may not move, let an assistant hold his hands, while you shake his shoulder and listen to hear on which side the pus makes a splash. Hope it is on the left so that you can make your incision on that side, for it is less deadly. If on account of the thickness of the tissues and the fulness of the cavity it does not give out a sound, so that you cannot make out where it is, which sometimes occurs, make an incision on the side which is more swollen and painful, rather below and behind the swollen part, so that an easy outlet may be afforded for the pus. First incise the skin between the ribs with a broad knife, then wind the blade of the knife with a strip of linen leaving out the point to the breadth of a thumb nail, and push it in. Then when you have let out as much pus as you think best, stuff the wound with a drain of raw flax to which a thread is attached. Let out the pus once a day. On the tenth day when you have let out all the pus dress it with fine linen. Then introduce through a small tube a mixture of oil and wine, warm, so that the lung which has gotten used to the moisture of the pus may not be suddenly dried. Draw out the liquid which has been injected at night in the morning, and that injected in the morning at night. When the pus becomes thin like water, and feels slippery to the finger and is small in quantity put in a hollow tin tent. When the cavity is entirely dry, cut off the drains a little at a time and allow the incision to heal, till you take out the drain. An indication that the patient will recover: if the pus is white, clear, and has fibers of blood (like blood clot?) they generally get well. If on the first day the discharge is the color of egg yolk, and in the next thin and greenish with a bad odor, they die when the pus has run out."

OPERATION FOR EMPYEMA (*Littré, ON DISEASES, vol. 7, pp. 150*).—After a long course of expectorants, *etc.*, he goes on: "If treated in this way these diseases get well unless a little of the sputum is left behind in the lung, and becomes purulent. Under these circumstances the cough becomes dry, and fever, chills, and orthopnea set in; the breathing is rapid and the voice a little harsher and the face is red on account of the temperature. As time goes on, the disease becomes more evident. If you get hold of the case within ten days, use a heating diet and warm baths, and inject into the lung something to cause the pus to be expelled, and employ all other means to produce this result, and let the régime be suited to empyema, and keep the head dry so that no additional fluid may run down from it. And if as a result of the infusions the pus is not softened and brought up, but ruptures from the lung into the thorax, after the rupture he seems to be well, because the pus has escaped from a small cavity into a large one and the inspired air gets into its proper place in the lung. But as time goes on the chest cavity is filled with pus, and the cough and fever and other painful symptoms afflict him more severely, and the disease becomes manifest. In that case one should wait 15 days after the rupture, so that the pus may mature again; because when

the pus escapes into the large space (in the chest) it becomes cooled and mixed with fluid already in the chest, so as to be only half purulent. If he begins to cough it up of his own accord during this time, assist nature by drugs and fluids, and during the last days after the rupture encourage him to get up before his muscles get too weak, and keep his head clear to prevent catarrh. If he does not cough it up, and the signs (of empyema) become evident in the chest, stop his food and drink, bathe him with warm water, place him on a firm seat, let an assistant take hold of his shoulders, and you yourself shake him, holding your ear to the chest, so as to see on which side the signs appear. Hope it is on the left, because it is more deadly to cauterize, or incise on the right. As much as the right side is the stronger, by so much the diseases on that side are more violent. If the fluid is too thick to splash so that there is no sound in the chest, while the breathing is rapid, the feet swollen, there is a short cough, do not be deceived, you may be sure that the chest is full of pus. Dip a thin piece of linen cloth in Eretrian clay, moistened and finely powdered, and wind it around the chest, and the place where it dries first is the place to cut or cauterize, as near as possible to the diaphragm, but be on your guard not to injure it. If you prefer you may anoint the chest with the Eretrian earth, and observe just as you did when you used the linen, being careful to anoint the whole chest at the same time, lest the part anointed first, dry too soon. After you cut or cauterize, use a drain of raw flax, and let the pus out gradually. When you are going to cut or cauterize, see that the patient keeps the same position that he is to be in when you operate, in order that you may not be deceived by the skin slipping upward or downward. In your treatment look out for coughing, that the pus may not be sucked back into the chest, but drained off dry as soon as possible. On the tenth day, let out all the remaining pus, stuff the opening with linen, and let out the pus twice a day, and keep the chest as dry as you can by régime. This is the way to examine and treat empyemata resulting either from injuries, pneumonia or severe catarrh, or falling of the lung against the pleura."

ON DISEASES (*Littré, Book II, vol. 7, pp. 93*).—ABSCCESS IN THE CHEST.—  
"When an abscess forms in the chest there is a dry cough, pain, and fever. There is a sensation of weight in the pleura, and a sharp pain always in the same place, severe thirst, warm drinks are regurgitated and the patient cannot lie on the painful side, but is able to lie on the unaffected side, but when he lies down he feels as if a stone were hung from him. The side swells and reddens, and the feet also swell. This requires incision or cautery, then let the pus run out till the tenth day and plug with raw flax. When the tenth day comes, inject warm wine and oil, so that the cavity may not at once become dry, and stuff with linen. Let out the injected fluid, and reinject. Do this four days running. When the fluid becomes as thin as strained barley broth, and small in amount, and sticky to the touch, put in a tin tube, and when the cavity is quite dry cut off a little of the tube and continue until the cavity contracts gradually down on it."

SERUM IN THE LUNG.—"If fluid gathers in the pleura, fever and cough take place, and rapid respiration, and swelling of the feet, and the nails all become curved, and the symptoms are those of empyema, but milder and more chronic. And if you perform infusion or give a vapor bath or fumigate, pus does not come up. In this way you can recognize that not pus, but serum, is present. And if you listen a long time with the ear against the chest, it boils inside like vinegar. This goes on for some time and then it ruptures into the (pleural) cavity. Then at first the patient seems well and free of his disease. Then in time the cavity fills up, and the same symptoms occur in

more aggravated form. In some cases the abdomen, the scrotum and the face become edematous, and some conclude the trouble comes from the lower abdomen, when they look at the swollen abdomen and edematous feet. For these swell also, if you fail to incise at the right moment. If such a patient shows external swelling he must be treated by an incision into the pleura. If external swelling is not present give a thorough hot bath, seat him as you do in empyema and on the side you hear the splashing sound incise. Try to make the incision as low as possible for better drainage. When you have incised, dress the incision with raw flax, making the drain thick and pointed at the end, and let as little of the fluid as possible escape at one time. Then if pus appears in the dressing on the fifth or sixth day, most of them get well, if it does not appear when you have drawn off all the serum, thirst and cough seize on the patient and he dies.

AUSCULTATION IN THE HIPPOCRATIC WRITINGS.—In paragraph 59 of the second book on "Diseases" the writer is describing a disease called "The Falling of the Lung Against the Chest Wall." He is undoubtedly speaking of the false membranes which develop in a dry pleurisy, and the friction rub which develops as a result. The writer describes the cough, painful and difficult respiration, states that a noise like leather is heard, and he adds, he seems to breathe through the chest. After describing the treatment he goes on to say, "If this results from a wound or from the incision of an empyema (for it sometimes does), tie a bladder to a tube, fill it with air and inject it into the chest, and put in a hard tin plug and push the lung back. You will have the best luck with this sort of treatment." Here is the ancient germ of nitrogen injections in phthisis, to push the lung away from the chest wall, and put it at rest.

We know that Laennec, the discoverer of auscultation, recognized that some of these facts about auscultation were hidden away in the Hippocratic writings from which neither he nor anyone else had unearthed them. He cites the passage in paragraph 61, on dropsy, on "Serum in the Lung." "And if you listen a long time with your ear against the chest, it boils inside like vinegar." I suppose these we should call "fine moist râles." Anyway he held his ear against the chest, and could hear more or less what was going on inside. That is the way he heard the friction rub "like leather," and that is how he heard the splashing sound in empyema. That is all we possess about auscultation in the Hippocratic writings, but that is sufficient to show that they were familiar with direct auscultation and recognized certain characteristic sounds. All these attempts, which were manifested intelligent interest, slept in their books without being developed, or even understood, till Laennec, who by controlling the sense of hearing by pathologic anatomy, pushed auscultation so far and rendered such service to the art of auscultation.

HYDROPS (*Littré, vol. 7, p. 224, Par. 23*).—"Hydrops results from causes like these. When one gets thirsty in the summer season, and drinks a great deal of water very fast, this disease is most likely to occur. For the lung being saturated discharges it into the chest. In the chest it causes severe fever so as to melt the fat, which surrounds the bronchi, and when the fat begins



to melt in large amounts, in a little while the serum collects. It occurs also when swellings appear in the lung, are filled with serum, and burst into the chest. That hydrops results from swellings in the lung, witness the occurrence of swellings both in the cow and the dog and the pig. In these quadrupeds most frequently occur swellings in the lung containing serum. If you incise them you will quickly recognize this fact, for the serum will flow out. It seems that such swellings occur in man much oftener than in cattle, for as much as we employ a more unhealthy diet. Many cases also of empyema have resulted from such swellings. The following symptoms occur at the outset of the disease: dry cough, hoarseness of the throat, chills, fever, and orthopnea, the skin is dropsical, the feet swell and the nails become curved. While the fluid is in the chest, the distress is severe, when it gets down into the lower abdomen, the patient seems easier. Then as the disease progresses and the abdomen gets filled up, the former symptoms return. Sometimes a swelling occurs on the chest, and shows us where to cut. If the point is not evident give a copious hot water bath, take hold of his shoulders and shake him, then listen to hear on which side there is more splashing. Having ascertained this cut down over the third rib from the last down to the bone. Then bore through it with an augur, and when you have cut through, let out a little of the serum, and having let it out plug it with raw flax and place a soft sponge over it; then bandage so that the plug will not fall out. The fluid ought to be let out once a day for 12 days. After the twelfth or thirteenth day let off all the fluid, and after that if any fluid collects, let it out, and administer foods which will dry the cavity. The following remedies ought to be administered after the operation. Prepare a dram's weight of silphium, grate a piece of aristolochia as big as a fawn's knuckle, take a pint measure of clean barley meal, and the same amount of lentils or vetch, mix this with honey and vinegar, and make 60 pastilles. Then every day dissolve one of these in a half a cup of dark wine, the more astringent the better, and let him take it on a fasting stomach. Order him to pursue the same regimen and exercise as previously, and if his legs and thighs swell, incise them confidently. If you treat the patient in this way, you will quickly restore him to health."

A brief extract from Hippocrates on "Wounds" or "Ulcers," shows that the Greeks had the same word for both, and that they had an idea of first intention, and aimed to get it when they thought it possible, but as our author remarked, "Judgment was difficult." Also we note they too moisten no wounds with anything but wine, which was the nearest thing to alcohol they had.

HIPPOCRATES, ON WOUNDS (*Kuhn, vol. 3, p. 307*).—"No wounds should be moistened with anything except wine unless the wound is in a joint. Because dryness is more nearly a condition of health, and moisture more nearly allied to disease. A wound in moist and healthy tissue is dry. It is better to leave a wound unbandaged, unless a cataplasm is applied. Certain wounds ought not to have cataplasms applied. Fresh wounds are less suitable for cataplasms than old ones, and wounds in the joints. Restriction in the amount of food, and drinking nothing but water are most useful in all wounds, more especially in the recent than those which are old, or for some reason inflamed, or likely to become so; or when danger of necrosis exists, or inflamed wounds about the joints, or where there is danger of convulsions; also in wounds of the abdomen, but most of all in fractures of the skull and femur or any other



bone. Standing erect does wounds the most harm, especially if the leg is the wounded part. Patients ought neither to walk about, or even be allowed the sitting position. Rest and quiet do the most good. Recent wounds, as well as the surrounding parts, will be less liable to inflammation, if one can induce suppuration as soon as possible, and not let the pus be blocked up in the opening of the wound, or if one can bring it about that it does not suppurate at all, except the little pus that necessarily appears, but keep it dry with some remedy that is not too harsh. For if it is dried to excess fever will come on, as indicated by chills and throbbing. For the wounds become inflamed when they are going to suppurate on account of the alteration and heating of the blood, till it softens and pus appears, in wounds of this sort at least. When you decide that a cataplasm is indicated, do not apply it to the wound, but to the surrounding parts, so that the pus may have free exit, and the tissues which are hardened rendered soft. In wounds made by the cut or thrust of a sharp weapon a remedy which will stop hemorrhage is indicated, as well as something which will prevent suppuration and dry up the wound. When the flesh has been lacerated and contused by the weapon, the wound should be treated in such a way as to produce suppuration as quickly as possible. Because (if this is done) it will be less inflamed, and the tissues which have been contused and lacerated and putrid and purulent have to soften and come away. After that new tissue sprouts up. It is a good plan in fresh wounds, except those in the abdomen, to allow a lot of blood to escape, as much as you think is required for the purpose, both from the wound itself, and any lacerations of the surrounding parts, especially in wounds of the leg or fingers or toes. On account of the escape of blood the parts are drier, and less swollen. These conditions prevent the wound from becoming moist, indeed, for the most part suppuration results from the presence of blood, and the changes which take place in that blood. It helps after the escape of the blood to bandage over such wounds a piece of sponge, soft and thick, and cut to the appropriate size, preferably dry, rather than moist, or to place leaves of delicate texture over the sponge. Oil or softening or greasy remedies are not good for such wounds, unless they are already well on their way to a cure. Oil is not good for fresh wounds either, neither are greasy or fatty remedies good for them especially when the wound needs a lot of cleansing. To sum up, use oil only for anointing in both winter and summer, or for such conditions as is needed.

"It is a good thing to move the bowels by enema in most wounds, especially in head injuries, and wounds of the abdomen and joints; also when there is danger of gangrene, in sutured wounds, in wounds which corrode, and undermine the tissues, and others which are slow to heal. But when you decide to bandage, do not smear on the ointment before you have thoroughly dried out the wound, then put it on; but sponge out the wound many times with a sponge, dry it with a clean dry fine linen cloth applying it many times. Having applied in this way the remedy which you think will be useful, either bandage it or not, as seems best. For most wounds warm weather is more favorable than winter except those in the head and abdomen. The equinoctial season is still better. These wounds which have been thoroughly cleansed as far as is necessary to make the granulations dry generally do not produce exuberant granulations. If a piece of bone has sloughed out on account of cauterization or trephining or any other cause, the scar resulting from the wound becomes concave and the cleansed wounds are reluctant to heal. They come together under compulsion, but not of their own accord. These in which the wound is surrounded by inflammation do not heal until the inflammation has ceased, nor are wounds likely to heal, in case the surrounding parts are

blackened either from softened blood, or blood supplied by an adjoining varicosity and they won't heal at all until you get the surrounding parts into a healthy condition.

CIRCULAR WOUNDS.—“If there is a cavity beneath, it ought to be incised clear around with a circular incision, or half way around, to an extent corresponding to the nature of the case. In every case complicated by erysipelas, the system should be cleaned out by catharsis in the direction most suitable to the particular cases, either upwards or downwards. When edema occurs around a wound, at a time after the inflammation has subsided, the edematous tissue has pus under it. A wound which has swollen on account of inflammation, and does not subside when the other parts which become inflamed at the same time have themselves subsided, is in danger of not healing readily. In cases resulting from falls or some other injury by which the tissues surrounding the wound are torn apart or crushed and swollen, and suppurate, the pus from the swollen part runs out of the wound. In these cases, if you think cataplasms are needed, do not apply the cataplasm to the wound. Rather apply it to the surrounding parts, so that the pus can get out, and the hardened tissues soften down. Where they have softened and the inflammation has ceased, bandage on sponges so as to bring the separated edges together, beginning with the healthy parts and gradually progressing. Bandage plenty of leaves over the sponge. When edges cannot be brought together because the tissues are moist, this tissue has to be cleared out. If the wound extends deeply under the flesh on both sides, both on account of the bandaging and the weight of the dressing it will rise up in curved surfaces in the center. If one will incise such a wound on a director, widely if it can be done, to allow free drainage, one should incise outward from the opening of the wound in the direction which seems to afford the best chance and in this way apply remedies, whatever you think are indicated. Generally speaking one ought to get a clear look straight into any wound which has a cavity in case there is no swelling. If now there is any putrefaction in it, or the flesh lining it is moist, and rotten, that wound and the surrounding tissues will be dark and greenish in appearance, and the mordant ulcers, where there is spreading gangrene, feed on the tissues and eat into them. This kind of ulcer also will be surrounded by dark greenish colored tissue.”

Page 134.—“A cataplasm for swelling and inflammation in the surrounding parts. Boiled mullein, raw trefoil leaves, with boiled sedum leaves and polium. If the wound needs to be cleared out these are all cleansing, also fig and olive leaves and leeks. These must all be boiled, and especially agnus (castus), fig, olive and pomegranate leaves. The following should be used raw. Mallow leaves crushed in wine, also leaves of red and green origanum. One should mix with all these flax seed roasted and powdered as finely as possible. When erysipelas threatens following a wound, crush the raw leaves of woad and apply with the flax seed, or moisten the flax seed with the juice of nightshade or woad, and apply it. When the wound itself is clean, but inflamed, together with the surrounding tissues, boil lentils in wine and reduced to a fine powder, use a little oil with it and spread it on and bandage. Also boil the leaves of the dog brier in water, powder it finely and spread it on. Spread a clean piece of thin white linen over it, and wet it with a mixture of wine and oil. When you want to bring the wound together prepare the leaves of the dog brier just as you did the lentils or nasturtiums and mix fine flax seed with it. This is the way to use flax seed and green agnus castus, and ‘apple alum,’ moisten them with vinegar.”

Page 326.—“Swellings of the feet of spontaneous or non-spontaneous origin which do not subside under cataplasms (either the swelling or the in-

flammation), or respond to bandaging or sponges or wool or something of the sort to the healthy part, but following this swell up of themselves and become inflamed, the reason for this is the congestion of blood in the veins, unless it is accounted for by a contusion. If a similar condition exists in any other part of the body, the cause is the same. Here the blood must be evacuated preferably by the veins over the part, if they are in evidence. If not, puncture the swellings deeply and at numerous points. In this case and any other where punctures are made, do it in this way, and employ the sharpest and thinnest knives, and when you take away the blood with the probe, do not bear down so hard as to produce contusions. Wash with vinegar and do not leave any clotted blood in the openings of the veins. Anoint carded, unwashed wool with a hemostatic remedy and bind it on loosely, drench with oil and wine, and put the bandaged part in such a position that the blood will flow upward (toward the body) and not downward. Put the patient on a light diet and let him drink nothing but water. If on removing the bandage you find the punctures inflamed, apply the cataplasm made from agnus castus and flax seed. If the punctures ulcerate and connect with one another, use the remedies suitable to finish the cure.

"When there is a varix in the leg either projecting or concealed beneath the skin, and the leg is bluish black and appears to need blood letting, by no means puncture the legs, because in most cases large ulcers result from the punctures, on account of the congestion of the veins. One should in these cases open the varix in several places, where it seems to be needed. When you open a vein, if when you loosen the fillet and let the blood out, it does not stop bleeding, hold the part so that the blood will flow in the opposite direction, whether in the leg or the arm, as if to force the blood backward, and have the patient lie in that position for a longer or shorter time. Then bandage in the same position, leaving no clot in the cuts. Then put on a double pad, after moistening it with wine, and above this clean wool soaked in oil. Even if the flow of blood is excessive this will stop it. If inflammation comes on because a blood clot forms in the incision, it will suppurate. The incisions should be made after partaking freely or moderately of breakfast with its accompanying liquid nourishment, and when the patient is warm, preferably on a warm day than a cold one.

"In applying a cupping glass, if blood continues to flow after you take away the glass, especially if much blood or ichor flows from the cuts put it on again quickly before it is filled, and suck out what is left. Otherwise clots will be left in the cuts and afterwards inflamed ulcers will result from them. Such cuts ought to be washed with vinegar and not moistened afterwards, nor should the patient lie on the cuts. Some hemostatic remedy ought to be rubbed into the cuts. When a cupping is required below the knee or over it, it should be applied with the patient standing, if he is able to stand."

The School of Coe treated hemorrhoids just as we do, by cautery, and ligature. Varicose veins were ligated and excised through multiple incisions. In the following brief description of the operation for hemorrhoids by two different writers in the Hippocratic collection, you will notice that the first writer who advocates the ligature advises the surgeon to leave one behind, presumably as we do, to avoid stricture, while the second states emphatically that all should be burned off. The advice of the second writer to let the patient cry out, because that helps to evert the rectum, is a grim reminder of what

both patient and surgeon had to endure for more than 2,000 years, until the advent of anesthesia.

HIPPOCRATES REGIMEN IN ACUTE DISEASES (*Kuhn, vol. 2, p. 99*).—LIGATURE.—“You may pierce hemorrhoids in the same way. Introduce with a needle a very coarse thread of unwashed wool, and tie off as much as possible; this treatment is safer. When it is thus compressed, treat it with remedies to cause necrosis and do not irrigate them till they have come away, and always leave one behind, *etc.*”

ON HEMORRHOIDS (*Kuhn, vol. 3, p. 340*).—CAUTERY.—“The mouths of the veins pour out blood for this reason. If bile or phlegm gets settled in the veins in the rectum, it heats these veins. The heated veins attract blood from the small veins nearest to them, the inside of the rectum is congested and swells, and the ends of the veins project, at the same time they are bruised by the feces passing out and ruptured by the collected blood, and spurt out blood, usually during dejections, sometimes without dejection taking place. Their treatment is as follows:

“First, one ought to know the peculiarities of their situation. For if you cut, excise, sew and ligate, or cause to putrefy tissues in the rectum, though these procedures seem terribly severe, you will not do any harm. I order seven or eight irons to be gotten ready, one span long and the thickness of a thick probe, curved at the end, width at the end as wide as a small obol. Purge the patient with a cathartic the day before; on the day you are to cauterize, put the man on his back with a pillow under his buttocks, and force the rectum outside as far as you can with your fingers. Get your irons white hot and burn till you dry them up and leave none untreated. Cauterize so as to leave none of the hemorrhoids uncauterized, but burn them all off. You will recognize the hemorrhoids without difficulty. They project into the interior of the rectum like bluish clusters of grapes, and spurt blood as soon as the rectum is turned inside out. Let the patient's hands and head be held while the cautery is at work, so that he cannot move, but let him shout, for that forces the rectum outwards. After the cauterization, boil lentils and vetch crushed in water till soft, and apply for five or six days. On the seventh cut a soft sponge into a thin strip. Let the sponge be six inches wide, then put over the sponge a piece of linen of equal size, thin and smooth, smeared with honey. Then put the index finger of your left hand under the middle of the sponge, and force this as far into the rectum as possible. Then put some wool under the sponge so that it will stay where it is in the rectum. Put a bandage around the waist and attach a strip to it behind, and bring it forward between the legs and bind it to the girdle at the navel. Bandage on also that medicine which I said hardens and thickens the skin. That ought to be bandaged on for no less than 20 days. Give him for nourishment once a day broth of wheat, flax, millet, or bran and let him drink water. When he sits down to stool, irrigate with warm water. Let him take a bath on the third day.

ANOTHER TREATMENT.—“Evert the rectum, and flush it thoroughly with warm water. Then cut off the tops of the hemorrhoids. Get ready this remedy before you cut. Urinate into a copper vessel, and sprinkle finely powdered copperas over the urine, then mix it by shaking the vessel and dry it in the sun. When it is dry, scrape the residue together, powder it finely, apply it with the finger, put a piece of oiled linen over it and bandage on a sponge above this.”

ANOTHER KIND OF HEMORRHOIDS.—“A second kind of tumor like a mulberry with projecting tissue grows on the veins, and if the condyloma, so



called, projects outside and is extensive, a kind of encircling lid covers the rectum. Let the man kneel and bend over two round stones and inspect, and you will find the parts between the buttocks close to the rectum swollen. Blood will flow from within, and if the tissue is soft under this lid the condyloma may be removed with the finger. It is no harder to do this than in skinning an animal to push the finger between the skin and the muscle. One should converse while doing this, and so do it without his knowledge. When you remove the condyloma, blood will certainly flow most profusely from the raw surface. Quickly wash the parts with astringent wine in which oak galls have been macerated and the bleeding vein will disappear with the condyloma, and the lid will go back to its former place, and cure will be easy.

"If the condylomata are higher up, look at it with a speculum and do not be deceived by the latter. Because when you open it, it smooths out the condyloma, when you close it, it shows it up as it is. Scrape it off with the finger, anointed with black hellebore and on the third day irrigate with astringent wine. Do not be surprised if blood does not flow when you remove the condyloma. If you make a cut in the joints or the arms or legs, blood will not flow. If you incise above or below the joints, you will find distended veins which will bleed, and it is difficult to stop the hemorrhage in good shape. The same is true in the rectum. If you cut above or below the place where the condyloma has been removed, blood will flow. If you just remove the condyloma at its point of attachment, it will not flow. If it turns out that way all is well, if not cauterize, and guard against the irons touching the tissues, but bringing them close so as to dry them, and then apply the copperas dissolved in urine."

ANOTHER WAY TO CURE HEMORRHOIDS.—"One should have a cautery made like a small reed used in making a fence, and fit the iron into it closely. Then put a cylindrical tube in the rectum, pass in the white hot cautery, take it out often, so that the heat may be endurable and no ulcer result from burning, and the cure may take place by drying the veins. But if you do not care either to cut or burn flood the rectum with warm water, evert it, triturate some smooth myrrh and gall to a fine powder, also Aegyptian aluminum, one and a half times as much, and the same quantity of dry ink powder and apply them dry. The hemorrhoids will drop off as a result of this medicine. Do this till they disappear. Half burnt copper sulphate will do the same thing. If you want to use a suppository take cuttle shell and plumbago a third part, a little alum and copperas, gall, a little verdigris. Moisten these with boiled honey, make a large suppository, and apply it till they disappear.

"In women hemorrhoids are to be treated as follows. Douche the rectum with warm water, in which some sweet smelling myrrh has been boiled. Take powdered myrrh, washed litharge and gall, add white wine oil and goose fat and mix them thoroughly, and prescribe their use after the douche. Evert the rectum as far as possible before douching."

For fistula in ano the Hippocratic writers employed the ligature and the knife. The description of the method will be omitted on account of its length. Rowing and equitation are mentioned as causes. For the ligature a five ply thread of raw flax was used with a horse hair incorporated in it, so that if the linen thread rotted and broke the horse hair could be used to pull another linen thread through. After the ligature is tied the patient is told to go about his business. The ancient Greeks must have been somewhat immune to ordinary annoyances if they could do that. If the ligature was unsuccessful the



fistula was to be cut open with the knife or a director and packed. Blind fistulae, close to the rectum, are to have the probe forced into the rectum. They may be irrigated, but as the author says, "they will not get well until they are cut open."

HEMORRHAGE.—In the Hippocratic writings I have found nothing about the ligature, the use only of styptics cauterly and pressure being advised. When we come to Galen he tells us when to try the wet Irish linen for ligatures, and advises if you cannot get that to use silk or catgut.

LIGATURE OF ARTERIES (*Galen, vol. 10, p. 941. Biblion N*).—"Sometimes hot blood full of exhalations is carried up to the head. Not the least useful of the remedies for this is arteriotomy. You have to shave the head and carefully locate the arteries behind the ear and in the forehead and the temples, and divide which appear to have more heat and pulsate most strongly. Of the smaller ones beneath the skin, if you cut a piece out of them, just as we are accustomed to do for varicose veins, you will do better. For instance, one of our best ophthalmologists cut out quite a piece of the artery which runs over the temporal muscles. Generally speaking, the ends which remain of the arteries which are cut often retreat into the connective tissues, and this applies especially to the small arteries which pulsate less violently. If on exposing it the artery appears large and pulsates violently, it is safer to apply a ligature first and then divide between. Let these ligatures be made of material which dissolves with difficulty. Such in Rome is that of the so called Gaietanoi, which is brought from the land of the Celts and is on sale mostly along the Via Sacra, which leads from the temple of Rome down to the agora. It is easy to get this in Rome, and it is very cheap. If you are practicing in another country, get silk ligatures, so called. The rich women in the Roman Empire use a great deal of this material, especially in the large cities, where there are many such women. If this cannot be obtained in the place where you happen to be, choose an aseptic material such as slender gut. For these soften easily and quickly come off from the vessels. We like to have them come off after (*i.e.*, not before), they have been covered by granulation tissue. The tissue that grows up around the cut ends of the vessels makes a kind of plug and closes the lumen. When this has occurred is the time when the ligatures may slough off with safety. The veins, on the other hand, if you ever happen to cut out a piece, it is not so necessary to ligate them with aseptic material, but anything else will do. In the case of the arteries, the continual motion opens up the mouths of the divided vessels. In the veins when they once close up, held together in any old way by a ligature, or puckered up by local applications, the surrounding tissue grows over it, especially when the patient who has been operated upon keeps still, yet more if this part is kept elevated, and the vessels have been emptied. That is just the way we treat varicosities. A varicosity is a dilated vein. Such veins occur oftenest in the legs and the scrotum."

I would like to take up the surgery of fractures of the skull, in which Hippocrates was most radical, advising opening the skull when contusion of the bone, or fracture was even suspected, and giving minute directions as to how to avoid injuries to the brain. Galen gave a wonderful description of fractures of the skull, and description of how to operate, enumerating many instruments, much like those we use now.

In order to continue the policy which was adopted at the beginning of this

paper, I thought I would collect all I could find actually stated about cancer in the Hippocratic writings and in those of Galen also. Although the search through Galen's 20 volumes is a good deal like hunting through the ocean for a few pearls of thought, as the resulting pearls are not very numerous, I will present them to you, though many may be found by future doing. It should be stated that the ancients regarded the accumulation of the so called "black bile" in the tissues as the cause of cancer.

## CANCER

HIPPOCRATES. OPERA (*B. Kuhn, I. p. 251*).—"Herpes is the least dangerous of all ulcers which feed on tissues, but are hard to get rid of just as hidden cancers are." (*Ibid. p. 204*).—"Old men do not have swollen glands of this sort, but they do have hidden cancers, and cancers of the extremities, and keep them till they die." APHORISM (1011). (*Kuhn, vol. 3, p. 754*).—"Those who have hidden cancers are better not treated. If treated they die off quickly; if not treated they live a long time."

HIPPOCRATES. DISEASES OF WOMEN (*p. 794*).—"In cases where the uterus falls upon the ischium, if not quickly moved away, and returned to their proper places, they become adherent (dried on) to the ischium. Necessarily, the cervix is elevated and held high up. As a result of this position the lips of the cervix are forced to close together. From being elevated and closed, it becomes hard, and because it is closed and crippled, so that the menstrual flow is shut off, it forces the fluid up into the breast, and chest, and the lower abdomen is swollen, and the inexperienced conclude that they are pregnant. They have the same symptoms, as women who are seven or eight months pregnant, and the abdomen enlarged so as to correspond to the time, the breasts swell and milk appears to be in them. When this amount of time has passed, the breasts shrink and become smaller, the abdomen does the same, and the milk disappears, and at the time when they thought the baby would arrive the abdominal swelling subsides. When this happens the uterus shrinks to a marked extent and you can hardly find the cervix, but everything is so shrunk and dried up."

*Ibid.*—(*Kuhn, vol. 2, p. 795*).—"And hard tumors appear in the breast, some large and some smaller, these do not suppurate, but continually grow harder and harder. From these grow hidden cancers. When cancers are about to come on, the mouth grows bitter, and every thing they eat tastes bitter, and if you give them more to eat, they refuse it, and shut their mouths. They become delirious, their eyes are hard and they do not see clearly, and pains dart from the breasts to the neck and beneath the shoulder blades, thirst seizes upon them, the nipples are dry, and the whole body becomes emaciated, the nostrils are dry and stopped up, and are not elevated with respiration. The breathing is superficial and they lose the sense of smell. Also they do not have pain in the ears, but sometimes convulsions. When they have gone as far as this, they do not recover, but die of this disease."

HIPPOCRATES. EPIDEMICS I.—(*Kuhn, vol. 3, p. 582*).—"A woman in Abdera had a carcinoma of the breast and bloody fluid ran from the nipple. When the discharge stopped she died. *Epidem. VII, p. 702*.—A woman of Abdera had a cancer of the breast. It was one of the following sort. Bloody fluid was discharged from the breast, and when it stopped, she died." *Epidem. VII, p. 699 (at bottom)*.—"A man who had a carcinoma in his pharynx and was cauterized by us got well."

GALEN. METHOD XVI.—OPERATION FOR CANCER (*Kuhn, vol. 10, p. 929*).—

"If you attempt to cure cancer by surgery, begin by cleaning out the melancholic tumor by cathartics. Make accurate incisions surrounding the whole tumor so as not to leave a single root. Let the blood flow and do not check it at once, but make pressure on the surrounding veins, so as to squeeze out the thick blood. Then treat as in other wounds." (*Kuhn, vol. 15, p. 331*).—"We have cured cancer in the early stages, but after it has reached a large size no one has cured it without operation." (*Kuhn, vol. 10, p. 141*).—"We have often seen in the breast a tumor exactly resembling the animal called the crab. Just as the crab has legs on both sides of his body, so in this disease the veins extending out from the unnatural growth, take the shape of a crab's legs. We have often cured this disease in its early stages, but after it is grown to a noticeable size no one has cured it without surgery. In all surgery we attempt to excise a pathologic tumor in a circle, in the region where it borders on the healthy tissue. On account of the size of the vessels, especially when they happen to be arteries, there is immediate danger of hemorrhage, but if you use ligatures, extension of the disease to the surrounding parts takes place. If we elect to cauterize the roots of the tumor, there is also no small danger connected with this when the cauterization takes place close to important organs. But in its beginning as I have said, we have often cured this disease, especially when the melancholic tumor is not excessively thick. This readily yields to cleansing remedies, with which it is treated."

CANCER OF THE INTESTINES: GALEN COMMENTARY ON HIPPOCRATES 25TH AP.—(*Kuhn, vol. 17, p. 688*).—"Dysentery resulting from black bile is fatal. Dysentery always is caused by that bile which is by some called 'green' and by some 'yellow'. Since the intestines are at first irritated by the bitterness of the humors, and then eroded, so as to ulcerate and produce dysentery. Dysentery resulting from 'black bile' is absolutely incurable, differing in no respect from cancer with ulceration. When we consider that such a cancer when it occurs on the surface is either hard to cure or entirely incurable, although all sorts of remedies may be brought in contact with it, it is certainly reasonable that when it occurs in the intestine and no longer cannot have a single drug brought in contact with it, but is irritated by the excretions which touch its surface, it should remain absolutely incurable."

CANCER OF THE UTERUS.—HIPPOCRATES, DISEASES OF WOMEN. (*Littre vol. 8, 337; p. 159*).—"In a woman when the uterus becomes hard, and projects through the vulva, when the groins become hard, and there is heat in the vulva, all this is likely to degenerate into cancer. Under these circumstances one should mash the interior portion of a wild cucumber and a piece of honeycomb, pour a cup of water over it and inject it into the rectum. This will produce a movement."

AMPUTATIONS: ALL GALEN SAYS ABOUT AMPUTATIONS IS TO BE GATHERED FROM HIPPOCRATES IN "JOINTS". XIII TO LXIX.—The best description of how amputations were done in ancient times occurs in Celsus de Gangrena. "If gangrene occurs anywhere between the finger or toe nail and the armpits or groins, and if medical treatment is unsuccessful, amputation ought to be done, I have elsewhere stated. I have also stated that this is accompanied by great danger. For often during the operation patients die of hemorrhage or shock. But this does not affect us, or at least there is a safe enough protection against it, and then is only once such. It consists of cutting with the knife at the line between the healthy and diseased tissue, clear to the bone, provided that the incision is not just at the joint, and one removes a little of the healthy tissue rather than leave any that is diseased. When

the bone is arrived at, the healthy tissue is to be pushed back from it, and a cut made around the bone, at the point where the bare part begins; then the bone is divided by a saw at the point as close as possible to the flesh still adherent to it. Then the edge of the bone, where the saw has roughened it, should be smoothed off, and the skin pulled over it, which should be loose in order that it may cover the bone as completely as possible. Where the skin cannot be drawn over it, it should be covered with linen and over that should be bandaged a sponge wrung out of vinegar. The after treatment should be carried out in the way prescribed for wounds, in which suppuration ought not to be induced."

#### ABSCESS OF THE KIDNEY

INCISION OF THE KIDNEY.—HIPPOCRATES, INTERNAL AFFECTIONS. (*Littre*, vol. 7, p. 203).—"There are four diseases arising from the kidneys. The following are the symptoms of the *First* of them. A sharp pain attacks the kidney and extends to the lumbar region and the hip and the testicles on the same side; urination is frequent and every little while there is suppression, and sand is passed with the urine, and when the sand comes out through the urethra, there is severe pain in that organ. When the urine is all passed the pain stops; after that the same pains recur, and when he urinates he rubs his penis on account of the pain. Many physicians who do not understand the disease, when they see the sand conclude that the patient has a stone in the bladder, but that is not the case, the gravel is in the kidney. This disease results from mucus, when mucus collects in the kidney, which cannot expel it, it hardens in places, forming small stones like gravel. When things are in this state, give the entire body a vapor bath, and then produce a moderate evacuation with the juice and seeds of scammony. On the following day evacuate with two cups of the juice of white chick pea, salt it at the time he drinks it. After that treat him by suitable foods and drinks, and baths and employ the remedies which are suited for strangury. When the pain is oppressive bathe copiously with hot water and apply hot applications to the part where the pain is most severe. When swelling occurs and becomes prominent, at that time make an incision into the kidney, let out the pus and treat the sand by diuretics. If the incision is made he has a chance to recover, if not, the disease will end in death."

SECOND DISEASE OF THE KIDNEYS.—"Violent pains oppress the patient as in the disease previously described. The disease results from hard labor, because the vessels in the kidneys become ruptured, so that the kidneys fill with blood. When this disease occurs the patient passes blood with the urine at the beginning, and later as time goes on, pus. If the patient will keep absolutely quiet he very quickly recovers. If he labors, the pains will take hold much harder. When the kidney contains pus, a swelling appears in the back. This patient under these circumstances you must incise deeply over the swelling, clear down into the kidney. If you hit it you will cure him right away. If you fail there is danger that the incision will prematurely close. If the wound grows together the cavity of the kidney will fill with pus; if it breaks into the bowel and passes by the rectum, there is hope of escape. But if it extends to the other kidney the patient is likely to die. Treat the patient with just the same remedies as in the previous disease, and employ the same regimen. The disease is a serious one, and may, as a result of it, go on to consumption of the kidneys.

"In the *Third* disease the urine appears like the juice of roast beef, and results from the pressure of black bile in the urine. The pains are similar to



those in the previous disease. Treated without operation, the disease never gets well. In addition to the remedies already stressed the drinking of whey and milk is recommended 'in season', for 25 days. If you carry out this treatment you may cause some benefit.

"The *Fourth* disease occurs in summer from the entrance of bile and phlegm into the urine. It also occurs as a result of excessive sexual intercourse. The pains involve the same parts as in the preceding, and resemble those of childbirth, and do not let up when he lies on the healthy side, but grow more severe, and seem to be suspended from the flank as if about to break away. If he lies on his face the pain stops. The feet and legs are cold, and the urine can hardly be passed on account of its heat and thickness. On standing, a sediment resembling barley meal is seen and if there is much bile it is reddish. If the mucus predominates it is white and thick. At first he suffers these symptoms for a year more or less. If the disease lasts a long time, the pain gets worse and suppuration takes place, and is accompanied by swelling, cut into the kidney, where the swelling is greatest and let out the pus, and if you hit it you will cure him right away." The remaining treatment is the same as in the previous diseases. "If you do these things and he does not get well at once, it will be nothing extraordinary, for this disease is obstinate."



## THE PRINCIPLES OF PHYSIOLOGY INVOLVED IN THE MANAGEMENT OF INCREASED INTRACRANIAL PRESSURE

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EVERY surgeon must think about his problems physiologically but it has been difficult for me on invitation to precipitate out of the medium of my own clinical thinking principles of physiology which are appropriate for publication. Exchange of ideas is so free among neurosurgeons that I can no longer recognize my own contributions and must therefore lay little or no claim to originality for the statements which follow.

The circulation of the cerebrospinal fluid which Cushing has aptly termed the third circulation may be obstructed at any point in its course from the ventricles where the fluid is formed to the fissure of Sylvius and subarachnoid spaces where it is absorbed. Such obstruction results in ventricular dilatation due to increase of ventricular pressure from the maximum normal of 100 Mm. of water to between 400 and 700 Mm. From a practical point of view it is my opinion that there is no such thing as a hypersecretive hydrocephalus, nor have I ever been able to recognize a hydrocephalus due to obliteration of the vein of Galen.

The result of blockage of the cerebrospinal fluid pathway is a ventricular dilatation which follows a certain pattern. The dilatation begins far proximal to the site of the block and works downward toward it. Thus blockage of the interpeduncular cistern at the base of the brain (Fig. 1, A) causes dilatation of the lateral and third ventricles initially and later on the aqueduct of Sylvius, the fourth ventricle, cisterna magna and finally the pontine cisternae more or less in that sequence.\*

When the dura is left open over an obstructed ventricle that ventricle enlarges with no decrease in the intraventricular pressure and the intervening portion of brain is destroyed with surprising rapidity. This destruction occurs whether the decompression be placed under the temporal or occipital muscle or elsewhere.

Thus after a negative exploration has been carried out in the presence of ventricular dilatation it is wiser to close the dura tightly unless it can rea-

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\*It should be pointed out that an occasional exceptional case is encountered in which the cerebrospinal fluid spaces are closed and the ventricles progressively enlarge without the measured intraventricular pressure rising above 150 to 200 Mm. of water. Such cases lead one to wonder what may be the effect upon the cerebral hemispheres of adequate closure of the subarachnoid space. Is the supposed circulation of fluid between perivascular space and subarachnoid space essential to normal metabolism of the cerebral tissue? Is it not possible that closure of that space may have a directly destructive effect upon the hemispheres?

sonably be hoped that the decompression may give to an underlying tumor enough added "elbow room" to free the cerebrospinal channels at the point of compression or unless it is desired to thin out the brain in a certain area so as to prepare the field for a second stage tumor removal.

In the case of a suboccipital craniotomy, if the tumor is found to extend so far forward that the surgeon cannot remove it completely the blockage of the basal cisternae is not relieved. Under such circumstances the result of leaving the dura open over the cerebellum would be the rapid destruction

Fig. 1



FIG. 1.—Sagittal section of skull. (A) Interpeduncular cistern. (B) Cisterna magna. Dotted line—Outlet for supratentorial structures. Broken line—Outlet of posterior fossa.

of the cerebellum with little or no relief of the hydrocephalus. True decompression and relief of the block could then be secured only by splitting the tentorium from its free margin outward (Fig. 2, broken line). This maneuver which has been recommended by Naffziger may well relieve both the aqueduct of Sylvius and basal cisternae so that the fluid may once again circulate freely.

Ventricular drainage into the tissues anywhere in the body results in absorption of fluid for a short time only. There forms rapidly an endothelium-like covering which seems to be an effective barrier to further fluid absorption. Such short lived absorption takes place into the scalp after many operations as evidenced by frequent postoperative pitting edema of the scalp and swelling about the eyes. Repeated puncture of the ventricles relieves the pressure temporarily but is followed in many instances by a higher rise

in the pressure as though the fluid formation had been increased by the temporary drop in the pressure of the fluid that bathes the choroid plexus.

The effect of expanding lesions above the tentorium demonstrates the fact that the brain is not a fluid structure and pressure is not conducted intracerebrally according to the laws which obtain in a closed fluid-filled space. An expanding lesion in one hemisphere produces a generalized increase of intracranial pressure, it is true, but the falx and tentorium offer enough resistance so that taken with the brain's elasticity the intrahemispherical pres-

Fig. 2

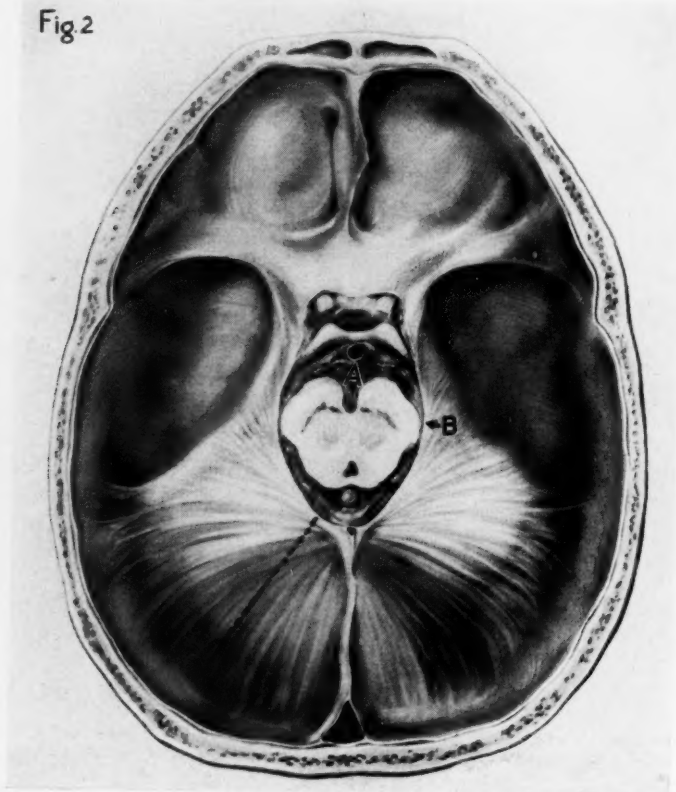


FIG. 2.—Base of skull with tentorium intact and brain stem transected at level of the incisura of the tentorium. (A) Interpeduncular cistern.

sure on the same side is greater than on the other side. Consequently when bilateral trepanation is performed in such a case cerebral tissue herniates through a small dural opening under greater pressure on the ipsilateral than it does on the contralateral side.

An expanding lesion in or upon one hemisphere usually produces a decrease in the size of the ventricle of the same side and an increase in the size of the ventricle of the opposite side. This increase very often amounts to dilatation. The mechanism of this contralateral hydrocephalus varies with the position of the expanding focus but for the most part pressure is exerted indirectly against the midbrain which cannot be displaced because it is ringed

## INTRACRANIAL PRESSURE

about by the falciform edge or incisura (Fig. 2). Thus, caught between the expanding hemisphere and incisura, the aqueduct of Sylvius is closed sufficiently so that fluid can escape through it only when the ventricular pressure becomes very high. This back pressure must act equally upon ipsilateral and contralateral ventricle, but the higher pressure within the ipsilateral hemisphere counteracts the tendency to dilatation on that side while the lower intracerebral pressure permits dilatation on the opposite side.

Such indirect pressure upon the midbrain may produce another effect of practical clinical importance. It causes the cerebral peduncle of the opposite side to be cut by the sharp edge of the incisura of the tentorium. This may result in a pyramidal defect on the ipsilateral side of the body including grave paresis.

For example, a patient whom I saw recently was found to have a right homonymous hemianopsia and paralysis of the left arm and leg. In the presence of increased intracranial pressure this indicated an expanding lesion of the left occipital lobe and a lesion of the pyramidal tract from the right hemisphere. Ventriculography showed the expanding lesion to be in the left occipital lobe as surmised and the right lateral ventricle to be dilated. An intracerebral blood clot was evacuated from this lobe and the patient rapidly recovered from the left hemiplegia. Thus the expansion within the left occipital lobe had affected the left motor cortex not at all but had compressed the midbrain against the opposite edge of the tentorium at B in Fig. 2, thus closing the aqueduct and injuring the opposite peduncle against this sharp edge.

In any case, of course, the cause of expansion should be removed radically but when this is impossible or ill-advised subtemporal decompression may be of the greatest help. The decompression should be on the side of the lesion and it may thus result not only in giving more "elbow room" for the brain but it may free the aqueduct of Sylvius from its compression between expanding lesion and tentorium and thus abolish the contralateral hydrocephalic pressure which can so seriously complicate the situation. Decompression on the opposite side would be of no help whatever and as we have pointed out above would only result in destruction of the portion of brain exposed.

Small lesions near one foramen of Monroe may, of course, produce a unilateral hydrocephalus on the same side of the cranial cavity. If an expanding lesion does not produce ventricular dilatation on either side then it may be temporarily relieved by subtemporal decompression on either or both sides.

As the result of an expanding lesion anywhere in the cranial cavity two pressure cones may be produced. First the temporal lobes may be crowded into the incisura of the tentorium (A, Fig. 1, and B, Fig. 2, dotted line), even to the extent of producing a bilateral pyramidal tract compression and probably also loss of consciousness. Secondly a pressure cone may be formed at the foramen magnum (Fig. 1, B), the outlet of the posterior fossa. A portion of the cerebellum is crowded down into this foramen producing

evidence of bulbar compression, Cheyne-Stokes breathing, and respiratory failure.

An expanding lesion in the posterior fossa presents certain characteristic difficulties. It causes local pressure and closes the aqueduct of Sylvius, thus producing hydrocephalus above the incisura of the tentorium. This results in a secondary pressure downward through the exit of the middle fossa (Fig. 1, A) against the already embarrassed structures in the posterior fossa which include the medulla oblongata. Such a lesion also tends to close the pathway for fluid through the basal cisternae as seen in Figs. 2 and 3. This in turn must further increase the pressure due to fluid formation by the choroid plexus within the fourth ventricle.

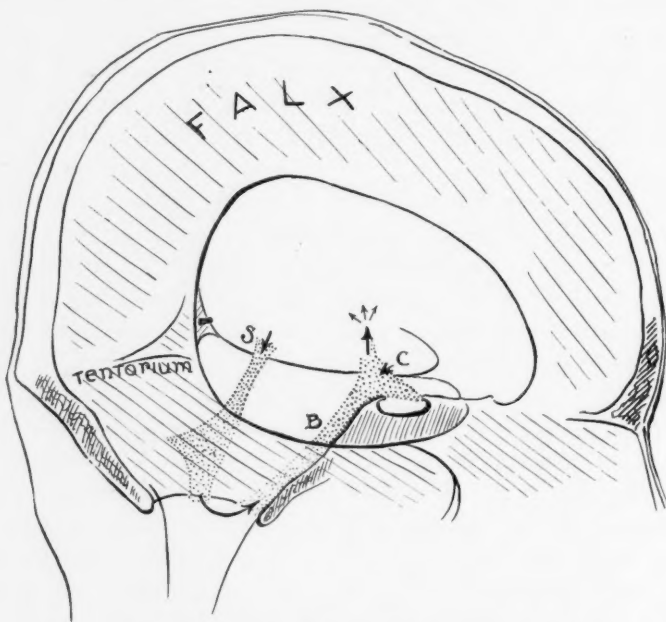


FIG. 3.—Schematic drawing of skull with dural reflections in place to show the relation of aqueduct of Sylvius (S), and basal cisternal passage (B) to the incisura of the tentorium. (C) Interpeduncular cistern.

This is, of course, the explanation of many of the sudden deaths that occur in such patients when they are straining, as at stool. This explains why a patient with a tumor of the posterior fossa who complains of transient attacks of dizziness or blackness before the eyes should be looked upon as a candidate for emergency operation.

Lumbar puncture should usually be avoided but if carried out should be done with a small needle and the pressure as shown by manometer never reduced by more than one-half its initial value. Encephalography by the lumbar route should usually be avoided but if carried out the pressure should be kept high, oxygen used instead of air and the spinal pressure at the close left at least as high as it was found initially.

If the ventricles are tapped oxygen should be used for ventriculography.



Instead of producing the dangerous secondary rise of pressure that follows air, oxygen seems to cause a fall of pressure, apparently being absorbed from the ventricles progressively, as pointed out to me by my associate, Doctor Cone. Here again, however, much less disturbance is produced if the gas is injected under a pressure equal to that of the preexisting ventricular fluid and not under a lower pressure. But, in spite of all this and however such injections are done, radical operation if indicated at all is best carried out the same day, for the least disturbance may upset the pressure balance and cause respiratory failure.

When bulbar ischemia has resulted in Cheyne-Stokes breathing or in arrest of respiration, oxygen by nasal catheter or tracheal tube is obviously indicated, and five or ten per cent of  $\text{CO}_2$  might be added without damage, as indicated by Carl Schmidt's recent work. After the bulb has been deprived of oxygen too long suboccipital decompression and opening of the foramen magnum and arch of atlas are of no avail. No tissue in the body is more certainly destroyed by ischemia of a few minutes' duration than the brain, as shown by Cobb and others, and the neurosurgeon who decompresses the medulla oblongata under artificial respiration only a few minutes too late is forced to watch his patient die a few hours later.

Diffuse cerebral edema is a baffling complication which follows cerebral trauma whether due to head injury or to operation. The question of its mechanism would lead us into a pathological discussion not called for in this address.

Following the work of Weed and Wegefath, hypertonic solutions were used intravenously by clinicians as well as magnesium sulphate by mouth or by rectum in order to lessen such swelling. It has been shown that this shrinking effect is transitory, disappearing often within the hour as measured by a needle left in the spinal canal, and some observers believe a greater pressure follows after the temporary relief. Consequently these procedures have recently become somewhat less frequently used. Lumbar puncture takes off the added weight of the pressure of ventricular fluid, the absorption of which is temporarily blocked by the superficial edema. Repeated lumbar punctures do not remove enough blood to be of any importance from that point of view for Sprong showed that however full of blood the spinal fluid may be, and even though the lumbar puncture needle be wielded by the most persistent of picadors not more than from two to five cc. of whole blood are actually thus removed in a whole series of punctures.

After operation, drainage of spinal fluid through a stab wound in the scalp is sufficiently safe for some days and will relieve the secondary complication of fluid pressure during the period of initial cerebral edema. At the time of closure a surgeon must decide whether he will leave the bone flap floating and thus allow strain to be exerted upon the scalp incision by cerebrospinal fluid, or whether he will wire the flap back into place. In making the former choice he is forced at times to defend the suture line by

aspiration beneath the flap or by drainage. In case the bone flap and dura are closed he is more often driven to lumbar puncture. In any case, whatever the technic, the intracranial pressure is lowered by any means that can be employed to drop the venous pressure of the large veins of the neck and the head should therefore be higher than the thorax and there must be no constriction of the neck after operation and when venous hemorrhage is feared most.

In conclusion, intelligent surgical therapy demands an understanding of the principles of physiology involved in cases of increased intracranial pressure. These principles include the mechanisms of hydrocephalic dilatation of the ventricles, the rôles of the falx, tentorium and foramen magnum under such circumstances and the uses and dangers of decompression.

DISCUSSION.—DR. WILLIAM J. MIXTER (Boston, Mass.).—It seems to me in the past we have done decompression without knowledge of what we were doing physiologically.

It has been a great pleasure to hear Doctor Penfield. He has given us reasons pro and con concerning decompression and I feel sure that the acceptance of these principles will be of great value.

I would like to ask Doctor Penfield why it is that a certain number of patients in the past who presumably had brain tumors which were never proven were markedly relieved for a considerable period of time by subtemporal decompressions.

DR. WILDER PENFIELD (Montreal, Canada).—I find it difficult to answer the question. I think there are a certain number of cases of pseudotumor which are in reality, of course, not tumor at all, but actually cases of collection of subdural fluid either secondary to trauma or secondary to some primary inflammatory process in one of the sinuses.

I think in those cases there is a collection of a fluid, high in protein, within the subdural space, which cannot escape. Consequently decompression allows the fluid to drain into the muscles and it does not reform, so that in some cases there have been permanent cures from decompression or trepanation.

## THE DIAGNOSTIC VALUE OF PHOSPHATASE DETERMINATIONS IN THE STUDY OF BONE TUMORS

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ROBISON<sup>1</sup> suggested in 1923, that the enzyme phosphatase played an important rôle in the formation of bone in the human body, and his theory is at present the most widely accepted explanation of the deposition of calcium salts in zones of ossification. A large amount of experimental evidence has strengthened this theory and has indicated that the osteoblast is the source of the enzyme.

Phosphatase is present in tissues wherever active ossification is taking place. It is also present in the intestinal mucosa and kidney in considerable amounts, but in these regions it is probably associated with the absorption and excretion of phosphorus. A small amount is found in the normal bones of adults, but it is present in the greatest concentration in the metaphyses of the bones of infants and embryos. This is reflected in the plasma phosphatase activity, which is somewhat greater during infancy and childhood.

In 1929, Kay<sup>2</sup> first reported that disturbances in bone metabolism are sometimes accompanied by an extraordinary increase in the amount of phosphatase enzyme in the blood plasma. Additional observations were reported by Kay<sup>3</sup> and Roberts<sup>4</sup> in 1930. These investigators were especially interested in the high levels of phosphatase activity in the blood in osteitis deformans. The elevation of the blood phosphatase activity in this disease has since been confirmed by many laboratories, and is now being used in several clinics as a quantitative test of the severity and progress of the disease, and also as an index of the efficacy of the therapeutic measures.

In their reports, Kay and Roberts both recorded miscellaneous observations on the blood plasma values in other diseases of bone, including bone tumors, and found that the phosphatase activity of the blood plasma was somewhat elevated in certain cases. More recently, Bodansky and Jaffe,<sup>5</sup> Austoni and Coggi,<sup>6</sup> and Coryn<sup>7</sup> have also reported series of phosphatase determinations in various bone disturbances. These reports indicate that it is considerably elevated in rickets and somewhat elevated in the regenerative stage of osteomyelitis. Hunsberger and Ferguson<sup>8</sup> have shown it to be slightly elevated during fracture repair. It is also elevated in jaundice (Roberts<sup>9</sup>). Albright, Aub and Bauer<sup>10</sup> have reported elevated blood phosphatase determinations in cases with osteitis fibrosa cystica in which the elevation is, roughly, in proportion to the degree of bone involvement.

During the past two years we have been making determinations of the phosphatase activity of the tumor tissue as well as of the blood plasma in

all cases of bone tumors made available to us. Many of these cases and the details of the methods employed in making the determinations have been reported by one of us in a previous communication (C. C. F.<sup>11</sup>).

The object of this report is to stimulate in other clinics interest in the study of the phosphatase content of the blood and tissues in cases of bone tumors, in order that a sufficient number of observations may accumulate to determine the value of the test as an aid in diagnosis.

We have followed Kay's<sup>12</sup> technic in the determination of the phosphatase activity of the blood plasma. By this method the phosphatase activity is expressed in arbitrary units the normal limit of which is about 0.26 units per cc. A few of the determinations here reported were made on blood serum by the Bodansky<sup>13</sup> method in the Chemical Laboratory of the Massachusetts General Hospital through the kindness of Dr. Fuller Albright, but the values have been translated into their approximate equivalents in Kay units to eliminate confusion. The normal upper limit for the Bodansky method is about five units per 100 cc. of serum. The technic for the determination of the phosphatase content of the tissues was modified slightly from that introduced by Martland and Robison,<sup>14</sup> and has been previously reported in detail.<sup>11</sup>

We have observations on 72 cases of bone tumors of various types. In 65 cases, we have observations on the blood plasma, in 32 cases on the tumor tissue, and in 21 on both. The diagnosis in all cases of primary bone tumors, and in many of the others, has been verified by biopsy, unless otherwise stated. These cases may be divided as follows:

TABLE I  
BONE TUMORS—PHOSPHATASE ACTIVITY  
*Cases Studied*

	Cases
(1) Osteochondroma.....	7
(2) Giant cell tumor.....	6
(3) Multiple myeloma.....	11
(4) Endothelial myeloma (Ewing).....	8
(5) Osteogenic sarcoma	
Osteoblastic type.....	13
Osteolytic type.....	3
Chondral type.....	2
(6) Adamantinoma.....	2
(7) Metastatic malignant disease.....	15
(8) Inflammatory conditions (tuberculosis, syphilis, etc.)....	4
(9) Myositis ossificans.....	1
Total.....	72

We have not included any cases of generalized osteitis fibrosa cystica in this series. We have also excluded osteitis deformans from considera-

tion for the elevation of plasma phosphatase in this disease is well known.

In the following discussion the average plasma phosphatase of cases of a given group at the time they first came under observation is reported, and the differences among the groups compared.

*Benign Osteogenic Tumors.* Osteochondroma (Seven Cases).—The plasma phosphatase in this group was within normal limits with the exception of one case, a tumor of rapid growth, in which it was slightly elevated. The average was 0.29 unit. The tumor phosphatase was in general elevated above that of normal bone (five cases); the average was 5.3 units per Gm.

*Giant Cell Tumor* (Six Cases).—The plasma phosphatase in three cases was normal and in two somewhat elevated. One of the latter two patients was a child of six years, and the other an adult with a large tumor and a pathologic fracture. The diagnosis in this case was not confirmed by biopsy. The average plasma phosphatase in this group was 0.31 unit. The tissue phosphatase activity (three cases) was moderately increased, averaging 8.5 units.

*Plasma Cell Myeloma* (11 Cases).—Only one case showed the plasma phosphatase above normal limits (0.34); the average was 0.19 unit. In patients presenting multiple destructive lesions of the bones by radiograph an elevated phosphatase seemed to be of value in differentiating myeloma from multiple metastases in carcinoma, or from generalized osteitis fibrosa; for in the two latter conditions the phosphatase was almost invariably elevated above the normal limits. We have two observations on myelomatous tissues, and in both the activity was negligible. It is interesting to note in passing that the serum protein in the blood was elevated in the seven cases in which the determination was made.

*Endothelial Myeloma* (Ewing Sarcoma), (Eight Cases).—In all cases but one, a postoperative case with recurrence in the lung and the ilium, the plasma phosphatase was somewhat increased but never more than twice the normal. The average for the eight cases was 0.27 unit. The level appeared to bear no relation to the extent of the disease. There was a negligible activity in the tumor tissue in the two cases available for study.

*Adamantinoma* (Two Cases).—In both cases the plasma phosphatase was within normal limits; the average was 0.19 unit. The tumor phosphatase activity was elevated in one to 15.5 units.

*Metastatic Malignant Disease in Bone* (15 Cases).—In every case of metastatic disease in bone, the plasma phosphatase was at the upper limits of normal or elevated. Eight of these patients were cases of carcinoma of the breast, two carcinoma of the kidney, two carcinoma of the prostate with bone metastases of the osteoblastic type, one neuroblastoma, and one melanotic sarcoma. The average plasma phosphatase of the entire group was 0.60 unit. As in myeloma, there seemed to be little relation between the extent of bone involvement and the plasma phosphatase reading. It was no greater in the osteoblastic form of cancer of the prostate than in metastases from cancer of



the breast with osteolytic lesions of similar extent. The phosphatase activity of metastatic tumor tissue was low, with the exception of the case of metastatic neuroblastoma, which in gross showed considerable new bone laid down in sun-ray pattern. In this case it was 26.4 units per Gm.

*Myositis Ossificans* (One Case).—The plasma phosphatase was considerably elevated (0.78 unit) when the patient was first seen, one month after the injury, and the radiogram at this time showed a large area of new bone in the quadriceps femoris muscle. Six weeks later the radiogram showed bone of a more adult character and the phosphatase had dropped to 0.38 unit.

*Inflammatory Conditions* (Four Cases).—Plasma determinations were made on one case of bone syphilis, one case of bone tuberculosis, and two cases of periosteal irritation caused by pressure from tumors of the soft parts. In none of these cases was the reading above a high normal.

*Osteogenic Sarcoma* (18 Cases).—The osteogenic sarcomata appeared to fall into three main groups as far as the phosphatase activity of the cells was concerned. These may be termed the osteolytic, osteoblastic and chondral types.

*Chondral Type* (Two Cases).—There were two examples of this form in the series. These tumors were of relatively slow growth and of a low degree of malignancy. Both have been submitted to and accepted by the Registry of Bone Sarcoma of the American College of Surgeons as sarcoma. Plasma determinations were not made on either of these cases. The activity of the tissue in both cases was low. The average was 3.8 units.

*Osteolytic Type* (Three Cases).—The plasma phosphatase was determined in one case, and was elevated to 0.43 units. Two tissue determinations showed moderate activity, 10.0 units.

*Osteoblastic Type* (13 Cases).—In the cases in this group the plasma phosphatase was greatly increased. There seemed to be little relation between the activity in the plasma and the size of the tumor, but the plasma value bore a definite relation to the enzyme activity of the tumor tissues. The average plasma activity was 1.22 units, or five times what may be considered a high normal. Both Kay, and Bodansky and Jaffe, have reported cases of bone sarcoma in which the activity of the plasma was from two to five times normal. The tissue phosphatase activity varied within wide limits but was high in every case with one exception. In this case, one of sarcoma in Paget's disease, the activity of the tumor tissue was negligible. This was also the only case in which the plasma phosphatase reading did not return to normal after amputation. There is a possibility that the tissue examined was not representative of the tumor, as it was taken from the periphery; but in several other instances the activity of the tissue from the soft peripheral portion of the tumor was as great as that from portions containing new formed bone. The average for the group was 65.9 units per Gm. of tissue.

Repeated blood determinations were made at intervals after surgical removal of the tumor in six cases in this group. In every case the phosphatase activity fell to normal within three weeks. This is shown graphically

# PHOSPHATASE IN BONE TUMORS

TABLE II  
PLASMA PHOSPHATASE ACTIVITY—BONE TUMORS  
(Normal Limits to 0.26 Units per cc. Kay's Method)

	Cases	Average Phosphatase Units per cc.
Osteochondroma.....	6	0.29
Giant cell tumor.....	5	0.31
Multiple myeloma.....	11	0.19
Endothelial myeloma (Ewing).....	8	0.27
Osteogenic sarcoma		
Osteolytic type.....	1	.43
Osteoblastic type.....	13	1.22
Metastatic carcinoma.....	14	.60
Adamantinoma.....	2	.19
Myositis ossificans.....	1	.78
Miscellaneous inflammatory.....	4	.20
Total.....	65	

TABLE III  
TUMOR TISSUE PHOSPHATASE ACTIVITY—BONE TUMORS

	Cases	Average Phosphatase Units per Gm.
Osteochondroma.....	5	5.3
Giant cell tumor.....	3	8.5
Multiple myeloma.....	2	Trace
Endothelial myeloma (Ewing).....	2	Trace
Osteogenic sarcoma		
Chondral type.....	2	3.8
Osteolytic type.....	2	10.0
Osteoblastic type.....	11	65.9
Metastatic carcinoma.....	4	1.3
Adamantinoma.....	1	15.5
Total.....	32	

in Chart I. One of these cases returned several months later with evidence of lung metastases, and at this time the plasma showed renewed activity. In a second case a normal plasma activity was found at the first determination, 20 months after amputation for an osteogenic sarcoma of the tibia. At this time the radiograph showed a small, indefinite shadow in the lung, and the diagnosis lay between calcified tuberculous nodes and metastatic sarcoma. Ten months later the shadow had increased and there was little doubt but that it represented metastasis. The phosphatase reading at this time was definitely elevated. We have been unable thus far to anticipate the radiologic diagnosis of lung metastases after amputation for sarcoma by examination of the blood. The reevaluation of the plasma phosphatase activity with recurrence of the tumor, however, somewhat parallels the observation of Ferguson<sup>15</sup> who demonstrated the reappearance of Prolan A in the urine with recurrence in certain cases of testicular tumors.

A fall in the plasma phosphatase was noted in two cases of osteogenic

sarcoma shortly before death. This may be interpreted as due either to necrosis of the tumor or to starvation.<sup>16</sup>

The effect of radiation of the tumor in relation to the activity was noted

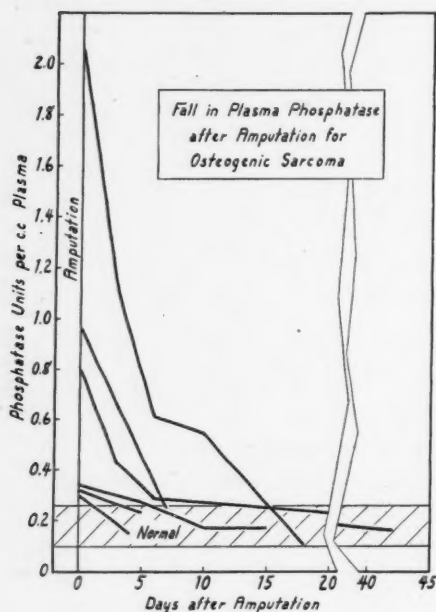


CHART 1

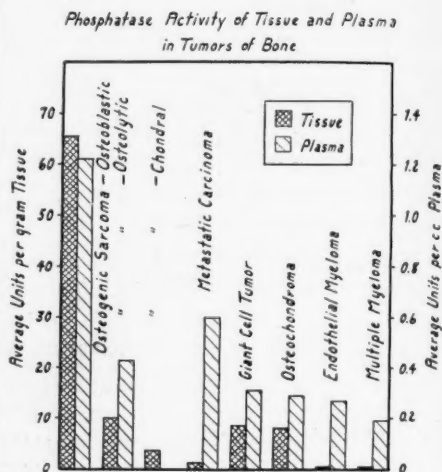


CHART 2

in one case. There was a temporary fall after radiation, but the reading later rose to a higher level than that recorded before treatment. Wilkins and Regen<sup>17</sup> have reported similar temporary inhibitory effects of radiation on the phosphatase activity in normal bones in young rabbits.

#### SUMMARY

From these observations on 72 cases it seems justifiable to draw certain tentative conclusions, although more work must be done before any authoritative statement of the value of the determination of the plasma phosphatase activity as an aid to the diagnosis of bone tumors can be made. We believe, however, that the test should be done whenever possible and that, taken in conjunction with other facts, it will be found to be of value in differentiating certain forms of bone tumor. The only tumors in which it was found consistently to be elevated were metastatic carcinoma and osteogenic sarcoma.

Our findings may be summarized as follows:

- (1) The plasma phosphatase reading is normal or low in non-malignant bone tumors.
- (2) It is normal or very slightly elevated in multiple myeloma and in endothelial myeloma (Ewing sarcoma).
- (3) It is normal or slightly elevated in the giant cell tumor of bone.
- (4) It is considerably elevated in malignant disease, metastatic in bone, and this fact may be of value in differentiating the multiple bone metastases of carcinoma from endothelial myeloma and multiple myeloma.

(5) It is consistently high in osteogenic sarcoma of the osteoblastic type. In the osteolytic type (one case) it is approximately the same as in the group of metastatic carcinoma and giant cell tumor.

(6) Following surgical removal of an osteogenic sarcoma the plasma phosphatase falls to normal in the course of from two to three weeks, but again becomes elevated when there are demonstrable metastases.

(7) The recurrent tumor must attain an appreciable size before an increased plasma phosphatase activity can be demonstrated.

(8) In individuals dying of osteogenic sarcoma the activity diminishes shortly before death.

(9) Radiation treatment of an osteogenic sarcoma caused a temporary diminution in the plasma phosphatase activity in one case.

(10) The plasma phosphatase activity bears a definite relation to that of the tumor tissue.

(11) The high phosphatase activity of the tumor tissue in osteogenic sarcoma is an example of a neoplastic cell continuing to produce the physiologic secretion of the normal cell from which it is derived.

(12) In one case of myositis ossificans the plasma reading was high at the time of osteoblastic activity in the lesion.

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DISCUSSION.—DR. CLIFFORD C. FRANSEEN (Boston, Mass.).—The enzyme phosphatase has become of increasing clinical importance in recent years. Its determination has already been used in such conditions as Paget's disease of bone, in hyperparathyroidism, and in rickets, in all of which the activity of the blood is high. In Paget's disease it appears to be a good index of the severity and the progress of the disease. A few reports of blood phosphatase determinations in bone tumors have appeared in the literature, but we have been unable to find any account of previous study of the phosphatase activity in bone tumor tissue. Since the enzyme can be found in great concentration in tissues where ossification is taking place, as in the metaphyses of embryo and infant bones, it appeared reasonable to suspect its presence in osteogenic tumor tissue. This we were first able to show over two years ago, and the present report is the result of subsequent study on both tissue and plasma.

The technic of the determination of phosphatase activity is not difficult and can be performed by any trained technician. It requires no apparatus other than that which is standard equipment in any clinical laboratory. The tissue determination requires a simple preliminary extraction in distilled water, and can be made on as little as one cubic centimeter of tissue. The phosphatase activity is measured by incubating the blood plasma or tissue extract with a buffered solution of a phosphoric ester under controlled conditions of time, temperature and pH. The number of milligrams of phosphorus split off by the enzyme is measured colorimetrically as in the ordinary phosphorus determination, and the value thus obtained is expressed in units of activity. The blood phosphatase determination has already been made a routine procedure in a number of hospitals.

The possible use of the tissue phosphatase activity as a supplement to pathologic study, in differentiating sarcomas of fibroblastic origin contiguous to bone from those of osteoblastic origin, is suggested from some of our observations. One biopsy specimen was of particular interest, since its phosphatase activity was high, although the microscopic picture resembled that of a fibrosarcoma. Since tumors of fibroblastic structure have at most a very slight phosphatase activity, the diagnosis of osteogenic sarcoma was offered and later confirmed at amputation. This seems to indicate that the osteoblast is already producing phosphatase in its undifferentiated state. Other specimens from the periphery of tumors have been examined and have shown as great an activity as central specimens containing osteoid tissue and new bone. We have not as yet had an opportunity to investigate this aspect of the problem thoroughly.

There is a growing number of examples among tumors of neoplastic cells which continue to produce the secretion of the cells from which they are derived, notably the adenomas of the endocrine glands. In all these instances, however, the secretion is a hormone. The present study suggests that we have here an example for an enzyme produced by the malignant osteoblasts.

We hold no brief for the phosphatase determination as the solution of all the difficulties encountered in the differential diagnosis of bone tumors, but in certain situations it may be of assistance. Additional observations are necessary to determine its ultimate value.



## SOME PHYSIOLOGIC PRINCIPLES INVOLVED IN THE SURGICAL TREATMENT OF GASTRIC AND DUODENAL ULCER

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THE problem of the cause of gastric and duodenal ulcer is of constant interest to the physician who has to deal with these lesions and to the biologist who recognizes in it a part of the more general question of the resistance of the gastro-intestinal tract to the digestive action of its own secretions. From the time of John Hunter various men have interested themselves in this problem and the view has steadily gained headway that ulcer of the stomach is in some way due to a local loss of resistance on the part of the mucous membrane to the digestant activity of the gastric juice. The term peptic ulcer is an expression of that view. The occurrence of the lesion in those parts of the alimentary tract that are exposed to gastric juice (lower esophagus, stomach, first portion of duodenum, jejunum adjacent to a gastro-enterostomy stoma, and ileum adjacent to the entrance of a Meckel's diverticulum containing gastric mucosa) and nowhere else may be taken as strong confirmatory evidence. But under normal conditions the mucous membrane of the stomach is not digested away.

During the past 15 years there has been a renewed interest in the problem and many significant observations made. As a direct result of various experimental procedures the disease has been caused to develop in the lower animal and to duplicate in almost every particular the lesion encountered in man. The gross and histologic appearance of the experimental ulcer exactly resembles the clinical lesion, and it has been observed to perforate, to cause profuse hemorrhage, and to heal under a type of medical management which resembles that found effective in man. In addition, the alterations in the physiology of the alimentary tract under which experimental ulcers may be expected to develop and become chronic are well understood and the factors involved may be fairly accurately appraised. Indeed, there are not many diseases whose immediate pathogeneses seem at present to be better established. It is the purpose of the present paper to offer a brief analysis of a part of this newer information and to present a summary of some of the experimental work carried on with various associates in my laboratory on this problem during the past few years.

The early literature is replete with unsuccessful attempts to produce a chronic progressive lesion in the gastric or duodenal mucosa of dogs. This effort has served, however, to make evident the great capacity of the gastric mucosa of these animals to heal in the presence of the usual gastric content and after the most extensive mechanical and chemical traumas. Exalto (1911) and Mann and his associates (1923) must be credited with being

the first to develop methods which regularly lead to the production of chronic ulcers without the use of external destructive agencies.

The normal resistance of the gastric wall to the digestant action of gastric juice has been explained as due to a general vital principle (Hunter), the protective action of gastric mucus (Pavy), the neutralizing effect of the alkaline blood in the mucosa capillaries, or to the presence of anti-pepsin in the stomach mucosa (Weinland), *etc.* It has been a fairly common assumption that the mucosa lining the gastric wall has some specific resistance to such digestion not possessed by other living tissues and entirely absent after death. In 1924, together with Vaughn,<sup>1</sup> I made an attempt to secure experimental evidence regarding the resistance of various tissues to gastric digestion. Large openings were produced in the stomach of dogs

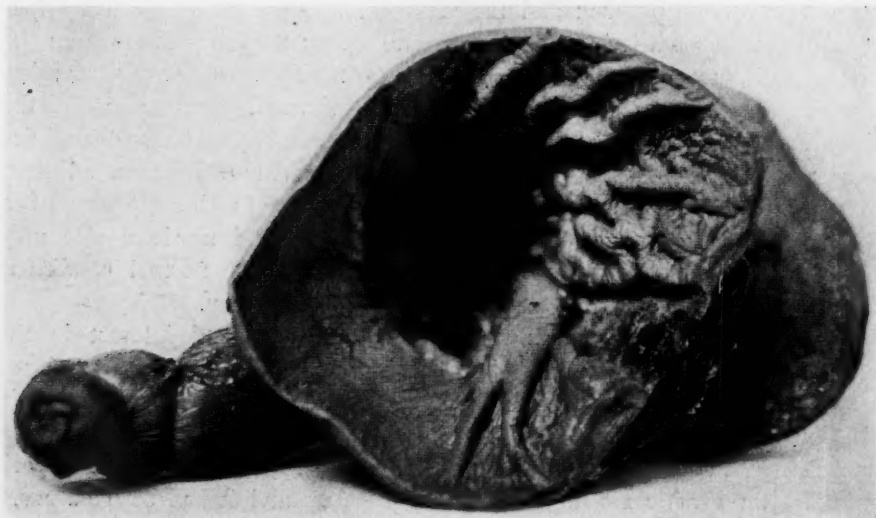


FIG. 1.—Implantation of the spleen in a window made in the anterior wall of the stomach, with exposure to gastric digestion for two weeks. The capsule of the spleen was removed before implantation so that the gastric content had direct access to the splenic pulp. The blood supply to the spleen was not interfered with. The spleen was not digested, although tests indicated that the gastric juice was normal. (From Dragstedt and Vaughn, *Arch. Surg.*, vol. 8, p. 791, 1924.)

and into these defects were carefully sutured segments of duodenum, ileum, colon, and such organs of the spleen, kidney, and pancreas. In the latter case the capsule of the organ was first removed so as to permit the gastric content access to the parenchyma. In no case were these tissues digested away. The exposed surfaces of the spleen and kidney were soon covered by a layer of newly formed gastric mucosa while the mucosa of the duodenal and intestinal implants remained entirely normal for periods of at least nine months (Figs. 1 and 2). In subsequent experiments<sup>2, 8</sup> similar defects were produced in the first part of the duodenum and the free portion of the pancreas sutured in place so that its parenchyma would be exposed to digestant action of the duodenal content. Digestion did not occur. It is thus evident that there exists a widespread resistance to the corrosive and solvent action of the gastric and duodenal content on the part

of tissues and organs whose blood supply is not interfered with. It should be emphasized that these experiments yield data only on the resistance of tissues to the normal gastric content but not to pure gastric juice. There is a significant difference between the two with respect to both acid and enzyme content. The concentration of free HCl in the stomach contents of normal man examined one hour after the administration of an Ewald meal varies between 30 and 60 clinical units, whereas that in the pure gastric juice secreted by the isolated stomach of the dog remains practically con-

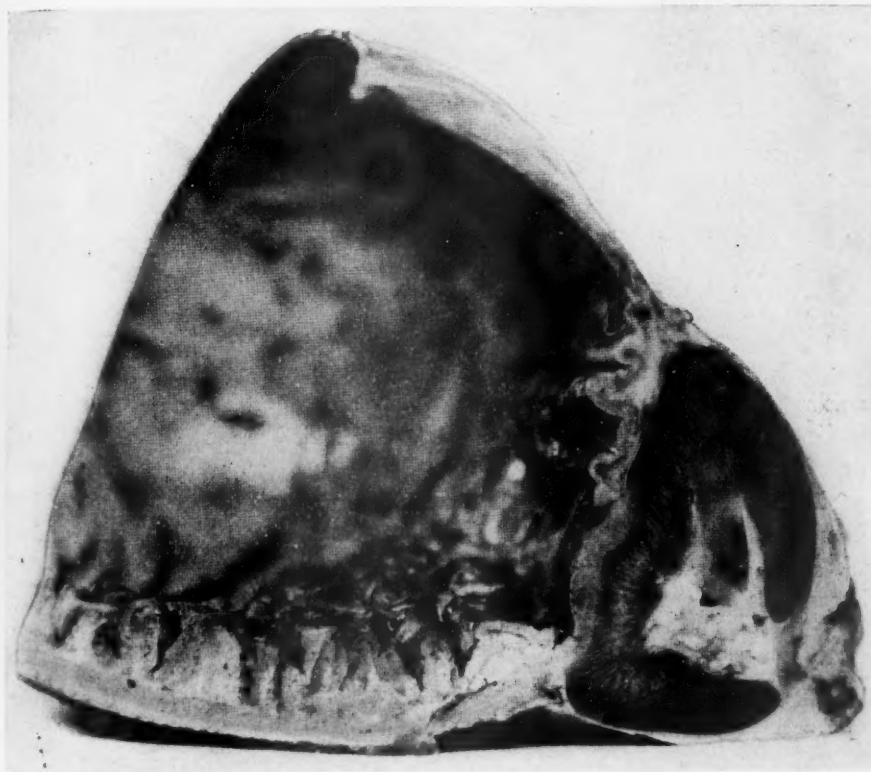


FIG. 2.—Implantation of the kidney in a window made in the anterior wall of the stomach, with exposure to gastric digestion for 14 days. The capsule of the kidney was first removed so that the parenchyma was directly exposed to the gastric content. There was no digestion of the kidney. (From Dragstedt and Vaughn, Arch. Surg., vol. 8, p. 791, 1924.)

stant at about 135 units. Carlson<sup>3</sup> has given a similar figure for the acidity of the pure undiluted gastric juice of man. The following evidence indicates that this pure gastric juice can digest any living tissue and that an ulcer may be expected to develop in any portion of the gastro-intestinal tract that is long exposed to a content that resembles it in acid and enzyme concentration.

A.—Organs such as the spleen and kidney, which were found to remain intact if implanted into windows made in the normal stomach, are promptly digested away if implanted into similar windows made in the isolated stomach pouch where they are exposed to the digestant action of pure gas-



Figs. 3 and 4.—Implantation of the spleen into a window made in an isolated pouch of the stomach. The parenchyma of the spleen exposed to the pure gastric juice of the Pavlov pouch was extensively digested.

*tric juice.* In two dogs, a large Pavlov accessory stomach was made employing for this purpose approximately two-thirds of the entire fundus. The pouch was connected to the exterior by means of a tight fitting metal cannula so that gastric juice could be retained or permitted to escape at will. A large window was then made in the accessory stomach and into this was carefully sutured the spleen, exactly as was done in the experiments with the normal stomach. For the first week or two the gastric juice secreted in the pouch was promptly drained away, the juice remained fairly clear

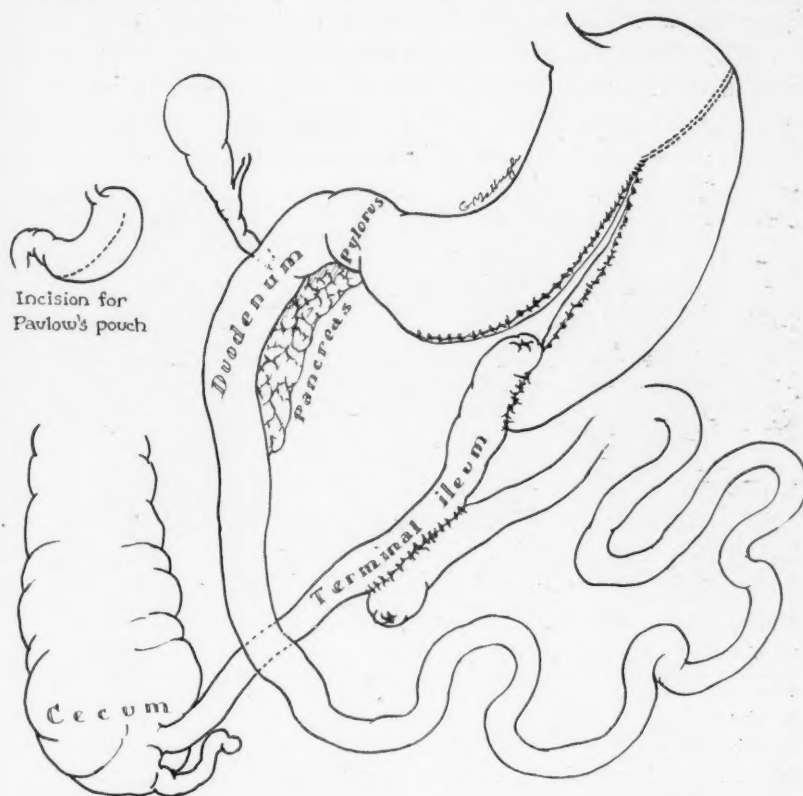


FIG. 5.—Diagram showing the method used to expose the mucosa of the ileum and jejunum to the digestant action of pure gastric juice. (From Matthews and Dragstedt, Surg., Gynec., and Obst., vol. 55, p. 265, 1932.)

and the condition of the animals excellent. The cap was then screwed over the cannula causing a retention of gastric juice in the pouch for daily periods of three to four hours. Care was taken not to permit the accumulation of sufficient secretion to distend the pouch and thus produce mechanical damage to the implant. The gastric juice draining from the pouch became immediately tinged with blood and in a few days repeated severe hemorrhages occurred. The dogs became markedly weak and cachectic. The specimens (Figs. 3 and 4) show the extensive digestion of the spleen by the pure gastric juice in striking contrast to the almost complete absence of such digestion by the normal gastric content.



B.—If pure gastric juice be caused to flow into the empty jejunum or ileum, the mucosa is digested away and an ulcer is formed. This experiment was performed in the following way (Fig. 5). A small isolated pouch of the dog stomach was made, in some cases with the vagus innervation intact (Pavlov pouch), in others with the vagi cut (Heidenhain pouch). The open end of these accessory stomach pouches was then sutured into the jejunum or ileum. Gastric juice secreted in the isolated stomach in response to meal taking passed immediately into the as yet empty intestine. In six animals in which the gastric juice was made to pass into the ileum an ulcer developed in the adjacent area in every case (100 per cent) and in the jejunum in 11 of a total of 13 experiments or 85 per cent<sup>4</sup> (Fig. 6). The ulcers always developed in the intestinal wall adjacent to the line of anastomosis with the stomach, but never in the gastric mucosa. They presented

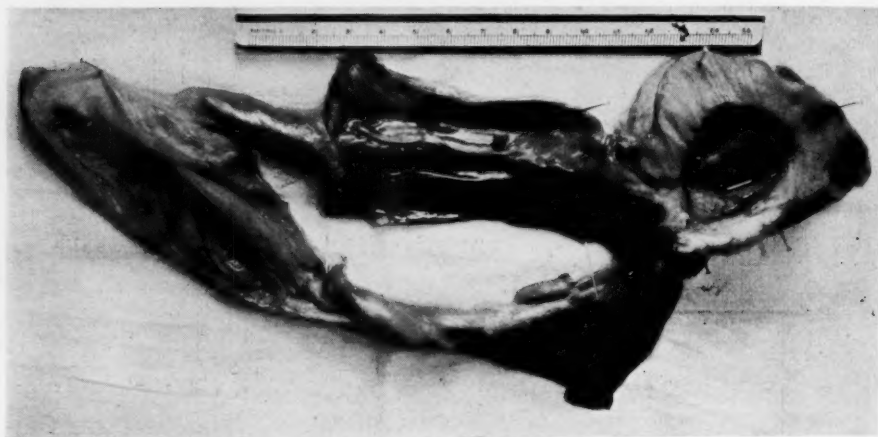


FIG. 6.—Showing a large ulcer in the jejunum near the anastomosis with the Pavlov pouch, as in Fig. 5. The unmixed gastric juice secreted by the isolated stomach has digested the jejunal mucosa. (From Matthews and Dragstedt, Surg., Gynec., and Obst., vol. 55, p. 265, 1932.)

the same clean, punched out appearance of the lesion in man. Several caused profuse hemorrhage, many perforated, and none showed any tendency toward spontaneous healing.

Nature performs an experiment similar to this in the so called Meckel's diverticulum ulcer, an example of which has recently come under my care.<sup>5</sup> Aschner and Karelitz<sup>6</sup> and Lindau and Wulff<sup>7</sup> have collected a number of cases in the literature in which an ulcer has been found in the ileum adjacent to the entrance of a Meckel's diverticulum. In these cases the diverticulum has been found to be lined with heterotopic mucosa which in some instances has been proved to secrete acid and pepsin.

C.—If the stomach be isolated from the gastro-intestinal tract in such a way that its blood supply and vagal innervation are but little interfered with and so that the gastric juice secreted is not promptly drained away but remains in contact with the gastric wall for a time, the gastric mucosa then

## GASTRIC AND DUODENAL ULCER

*becomes digested away and chronic progressive perforating ulcers develop that anatomically are not distinguishable from the clinical lesion.*

In a study of the physiology of gastric secretion, Lim, Ivy, and McCarthy in 1925 isolated the entire stomach of dogs, and sutured the lower end of the esophagus to the open end of the duodenum. Although the vagus nerves to the isolated stomach were cut, from 300 to 400 cc. of highly acid

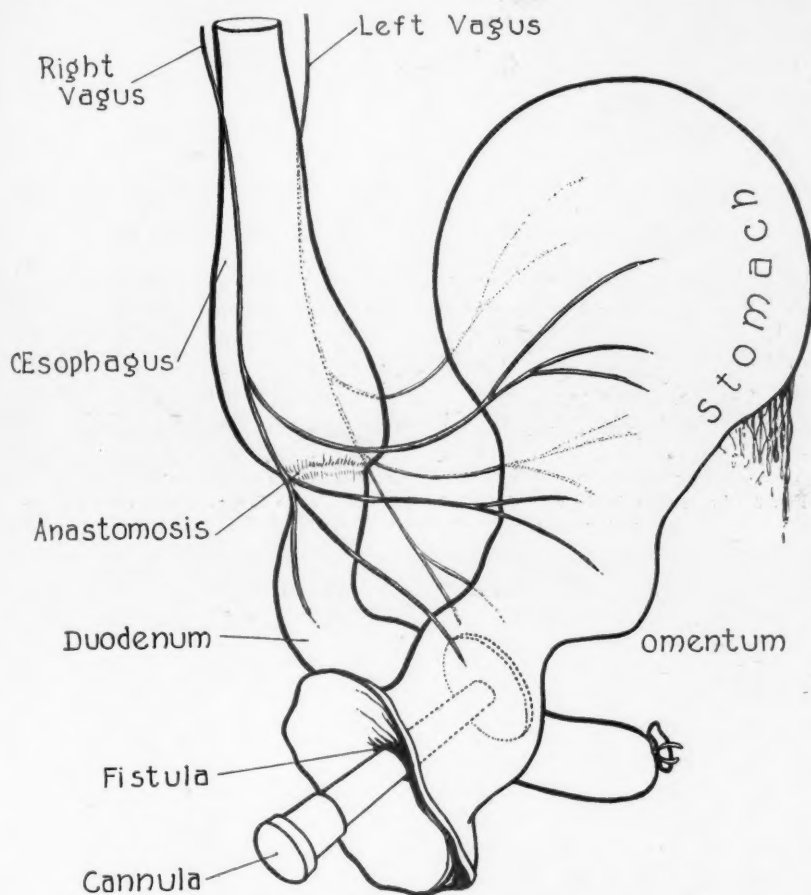


FIG. 7.—Diagram showing the method of preparation of the isolated stomach with vagus innervation intact. (From Dragstedt and Ellis: *Am. Jour. Physiol.*, vol. 93, p. 407, 1930.)

proteolytic gastric juice were secreted daily. It occurred to us that a more physiologic preparation would be one in which the vagus innervation of the stomach was preserved, if possible, since the Pavlov pouch in which this is the case more nearly mirrors the activity of the normal stomach than does the Heidenhain pouch where the nerves have been severed. In a number of instances we were successful in so isolating the entire stomach that its blood supply and vagus innervation were left intact (Fig. 7). To our surprise, such an isolated stomach was found to secrete on an average about 2,000 cc. of gastric juice per 24 hours. The free hydrochloric acid of this secretion varied between 100 and 140 clinical units and its pepsin concentration

was approximately three times as great as that of the normal gastric content. The continued loss of this secretion produced dehydration, hypo-

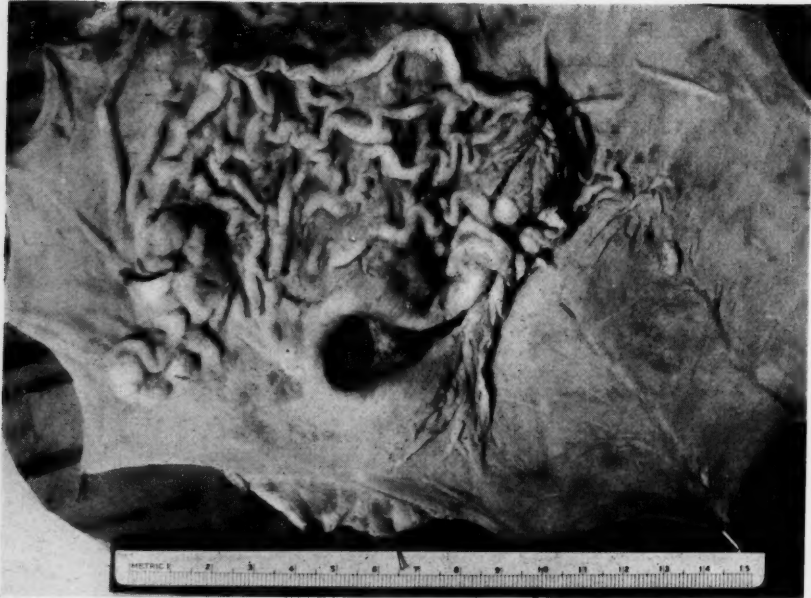


FIG. 8.—Large ulcer in the wall of the isolated stomach, as in Fig. 7. Death from perforation and peritonitis 20 days after original operation.

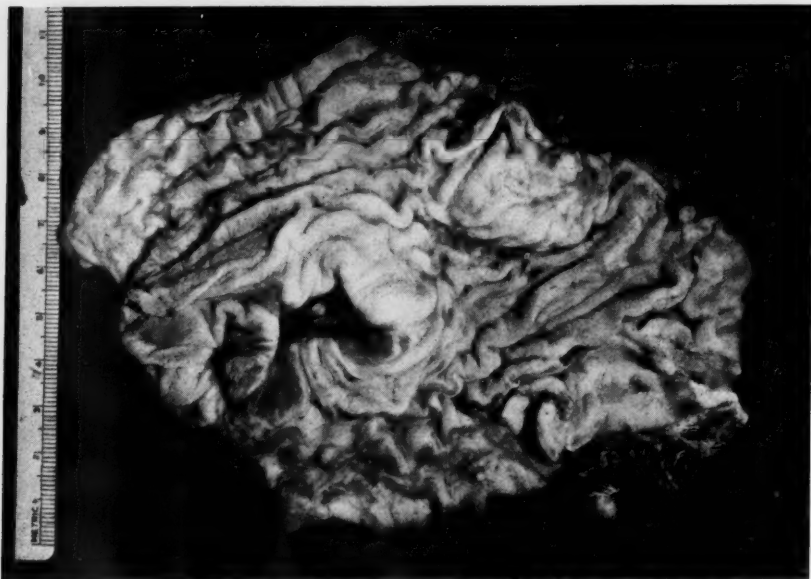


FIG. 9.—Large ulcer in the wall of the isolated stomach, as in Fig. 7. Death from perforation and peritonitis 43 days after original operation.

chloremia, alkalosis, and eventually death unless sodium chloride was supplied in large amounts by intravenous injection. During the course of these experiments we came to the realization that if this pure gastric juice was

permitted to accumulate in the isolated stomach or if its drainage to the outside was not adequate, ulcers would develop in the gastric mucosa. To date typical chronic ulcers have been noted in seven animals (Figs. 8 and 9). In several instances these caused death from hemorrhage and in two cases from perforation. In one experiment, in which death occurred from pneumonia 48 hours after the operation, several superficial ulcers were found and the entire mucous membrane presented numerous small erosions, areas of round cell and leukocytic infiltration, and hemorrhages quite similar to those described by Konjetzny<sup>14</sup> as characteristic of ulcer gastritis (Figs. 10 and 11).

If we may conclude from these experimental observations that pure



FIG. 10.—Large superficial ulcer and multiple erosions on the wall of an isolated stomach as in Fig. 7. Death from pneumonia 48 hours after operation.

gastric juice can digest away living tissues including the mucosa of the digestive tube, the question may be raised as to the substance in gastric juice responsible for this effect. Our inquiry in this respect has been limited to pepsin and free hydrochloric acid. If one can judge at all by the widespread use of the term peptic ulcer it would appear that many regard pepsin as the responsible corroding agent. In this connection it is perhaps pertinent to point out that trypsin is an even more active proteolytic enzyme but no ulcers have been reported in that part of the digestive tract exposed to pancreatic juice. The question is not entirely an academic one. The late Doctor Sippy based his method of treatment on the idea that pepsin was the principal agent that prevented the healing of ulcer and so endeavored to prevent the activation of the pepsinogen by preventing the appearance of free acid in the gastric content at any time. Very large amounts of alkalis were sometimes necessary to secure such complete neutralization.

Claude Bernard showed many years ago that the leg of a living frog

would be digested away if introduced through a fistula into the cavity of a dog's stomach. We have confirmed this observation in *in vitro* experiments<sup>1</sup> and have modified the method in an attempt to assay the relative importance of acid and of pepsin. The hind legs of living frogs were immersed in pure gastric juice, in pure pancreatic juice, and in gastric juice containing varying concentrations of free hydrochloric acid and pepsin. The legs immersed in pure gastric juice were gradually digested away so that in a few hours all that remained was a branching network of blood vessels surrounding the bones. Although usually the last to persist, the vessels were finally eroded and death from hemorrhage occurred. It is interesting that pure activated pancreatic juice had no such digestant effect and the skin remained intact though edematous even after 25 hours' exposure. Pure gastric juice of



FIG. 11.—Low power photomicrograph of one of the superficial erosions in the gastric mucosa of the isolated stomach of Fig. 10.

normal pepsin concentration but whose free acidity was reduced to 30 clinical units or less had no digestant or corrosive action, whereas juice having a concentration of free acid of 50 units or more had a very marked effect almost irrespective of the concentration of pepsin. When the concentration of free acid and of pepsin was varied in different samples, the extent of digestion of the living tissue was proportionate to the concentration of free acid and not at all to the concentration of pepsin. Somewhere between 0.1 and 0.15 per cent of free hydrochloric acid was found to be the critical level at or above which living tissue was digested. At this concentration it made little difference whether the concentration of pepsin was 600 or 20 units per cc. It is doubtless significant that the acidity of the normal gastric content rarely rises above this level and that the high values which approach the acidity of pure juice are commonly found in ulcer patients.

It must be admitted that the experimental conditions under which the



ulcers described above have been caused to develop are highly artificial and with few exceptions their counterpart does not occur in man. If it be agreed that the evidence warrants the conclusion that a gastric content whose acidity and pepsin concentration approaches that of pure gastric juice will digest the wall of the stomach or duodenum and produce an ulcer and is in this sense its immediate cause, there still remains the question—under what conditions, if any, does such a content appear? This latter problem is obviously of greater practical significance and here unfortunately our information is far less precise. It seems clear enough from a consideration of the normal mechanisms that govern the secretion of gastric juice, that a pure undiluted and unneutralized secretion is not apt to accumulate in the stomach. The sight, odor, and especially the taste of food which serve as appropriate stimuli for the nervous phase of gastric secretion are followed so promptly by the ingestion of food that the juice is diluted and neutralized. Similarly the gastric secretion which results from the action of gastrin takes place only while food is in the stomach and upper intestine. Under normal conditions of motility the gastric content is passed on into the duodenum before its capacity to bind or neutralize the free hydrochloric acid is entirely overcome, so that we never observe in the digesting stomach a free acidity equal to that of pure juice and rarely an acidity above that at which gastric juice was found capable of digesting living tissue. When an abnormal retention of food in the stomach occurs, we should expect on theoretical grounds that the continuing secretion of gastric juice would gradually raise the acidity of the gastric content until it approaches the acidity of the pure secretion. There is, of course, plenty of clinical data to substantiate this view and the hyperacidity of the gastric content in cases of duodenal ulcer with pyloric obstruction has long been regarded as a significant factor in determining the chronicity of these lesions. It is not improbable that pyloric stenosis or spasm may operate also in another way to raise the acidity of the gastric content. It was found by Mann<sup>9</sup> and confirmed by ourselves and others that the experimental deviation of the alkaline pancreatic juice from the duodenum into the lower intestine or to the exterior is shortly followed by the appearance of chronic progressive ulcers in the duodenum. A few clinical cases have been described in which it appears that a failure of bile or pancreatic juice or both to reach the duodenum and neutralize the gastric content had been responsible for the occurrence of the duodenal ulcer. The practical significance of Mann's discovery, entirely apart from its theoretical importance, may, however, be much wider. According to the views of Boldyreff<sup>10</sup> a reflux of bile and pancreatic juice into the stomach normally occurs and serves to prevent the development of a high concentration of acid in the gastric content. Spasm of the pylorus and especially when associated with a stenosing duodenal ulcer might be expected to limit such regurgitation as well as cause retention and thus set up a vicious circle whereby the increasing acidity of the gastric content increases the pylorospasm. It seems reasonable to conclude that the major factor in determining the chronicity of ulcer

in the pyloric region is the resulting stenosis or spasm which acts thus in two ways to increase the acidity of the gastric content. The treatment of such a lesion, therefore, which does not return the emptying time of the stomach to normal may be expected to be followed by recurrence.

It is not easy to evaluate the rôle of the central nervous system and the undoubted effect of the stress and strain of modern life (Rivers<sup>11</sup>), in the pathogenesis of ulcer. Ulcers can be caused to form in portions of the gastro-intestinal tract entirely severed from any central nervous system connections so that I believe the immediate cause of the lesions is local. On the other hand, the vagi contain secretory fibers to the stomach and it is theoretically possible that these might be stimulated by other than the normal mechanism and there results a secretion of gastric juice in the empty stomach which if marked or persistent might cause ulcer. In 1927, Silberman<sup>12</sup> secured the secretion of gastric juice in the empty stomach by reflexly stimulating these secretory nerves. He performed double esophagostomy in dogs and gave these animals sham feedings for 40 to 60 minutes three times each day. Gastric or duodenal ulcers or erosions appeared in 18 of these dogs after periods of 16 to 49 days, and the acidity of the gastric content varied between 68 and 103 clinical units. It is possible that the acute ulcers and erosions observed by Dr. Harvey Cushing<sup>13</sup> in patients following operations for cerebellar tumor have an etiology similar to those in Silberman's experiments. It is not improbable that the operative trauma to the interbrain might stimulate the gastric secretory centers associated with the vagus center and cause a large secretion of gastric juice in the empty stomach, such as was secured by the sham feeding experiments. An examination of the gastric content after such cerebral traumas would be of great interest.

A continuous secretion of gastric juice into the empty stomach during the entire 24 hours occurs both in man and lower animals. The cause of this secretion (nervous or hormonal), its amount, and its variations under physiologic and pathologic conditions are but little understood. Normally the amount seems to be small and it is readily neutralized by the gastric mucus, swallowed saliva, and regurgitated bile and pancreatic juice. There is considerable evidence that in ulcer patients the volume of this continuous secretion is greatly augmented. Does this represent hyperactivity or hyper-tonicity of the vagus secretory mechanism as a result of continued mental strain? If so, vagus secretion may find a definite place in ulcer therapy. On the other hand, acute emotional stress definitely inhibits gastric motility and prolongs its emptying time and it is entirely possible that in this way may be significant in the clinical problem.

Considerable variation exists in the resistance of various parts of the alimentary canal and other tissues to the digestant action of pure gastric juice. When the secretion from an isolated Pavlov pouch was drained into the jejunum and ileum, several weeks were required before ulcers developed, whereas the exposed spleen was extensively digested in a few days. The ileum was found to be definitely more susceptible than the jejunum and in

every instance the gastric mucosa proved to be most resistant. This lessened resistance of the small intestine to the digestant action of gastric juice must always constitute an objection to all forms of surgical therapy in which an artificial opening is made between the stomach and jejunum. In those cases where the increased acidity of the gastric content is due to retention and where the operation corrects this defect the danger of jejunal ulcer should be minimal. The advisability of a large stoma to facilitate the emptying of the stomach seems indicated. The superior resistance of the duodenal mucosa as determined by experiment suggests that gastroduodenostomy or pyloroplasty, where conditions permit their employment, are preferable to gastrojejunostomy. On the other hand, when pyloric stenosis does not exist or where the increased acidity of the gastric content is due to excessive continuous secretion of gastric juice, the probability of recurrence or secondary jejunal ulcer is very real.

The development of typical ulcers in the wall of the isolated stomach proves that pure gastric juice can digest the gastric mucosa and makes it unnecessary to postulate a specific loss of resistance to account for ulcers in the stomach proper. The careful histologic examination of a large number of resected specimens in Konjetzny's<sup>14</sup> material failed to reveal evidence of local vascular injury, embolism, or thrombosis. It is not to be supposed that the resistance to digestion of the mucosa would always be uniform throughout or that a uniform exposure of the entire surface would always occur. Such variations should be of chief significance in determining the site of the resulting ulcer and its shape. The more general effect is manifested by the small erosions, hemorrhages, and cellular infiltrations in the neighboring more resistant or less exposed mucosa. According to this view the so called ulcer gastritis is of similar origin to the ulcer itself, is more amenable to medical treatment, and cannot be considered an indication for partial gastrectomy.

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DISCUSSION.—DR. EDWARD S. JUDD (Rochester, Minn.).—We are all greatly indebted to Doctor Dragstedt for this work. As you all know, he has investigated the pathogenesis of peptic ulcer for a great many years and has done a very good job. I hope we can make our surgical work conform to the principles that he has laid down and I think he has come closer to helping us out than any other research worker. The results which he has obtained from these experiments are strictly in accord with those obtained by Mann, Williamson and Bollman in the Mayo Clinic. It seems to me that we all feel that their experiments give sufficient evidence to show that a gastric content of sufficient acidity and concentration of pepsin can digest the normal mucous membrane of the stomach and duodenum and produce an ulcer. I think that it is, as Doctor Dragstedt says, unnecessary to postulate some local thrombosis, infection, or embolism, as has been suggested by some former investigators. When resistance is locally decreased, the digestive ability of the gastric juice undoubtedly will be more effective in producing and maintaining ulcer. I also fully agree with what Doctor Dragstedt says about gastritis as described by Konjetzny; namely, that it is attributable to the chemical action of the gastric content and that the condition is corrected when the acidity is controlled. I fully concur in his conclusion that, for this reason, the finding of extensive gastritis is not an indication for partial gastrectomy.

Mann and Bollman have stated, in an article on experimentally produced peptic ulcers, that two types of ulcerative lesions of the gastric and duodenal mucosa are produced experimentally: "The ulcerative type most often produced has always remained acute; it is usually multiple and is more often distributed throughout the mucosa of the fundus than in the mucosa of the pylorus or duodenum. The exact site of occurrence of the lesions is never definite or constant. They start as a hemorrhage in the submucosa, and the lesion of the mucosa appears secondary to the vascular injury. This type of lesion is readily produced experimentally by various means. It occurs in the so called toxic conditions, after the injection of toxins, certain drugs and bacteria, and in some moribund conditions that follow the loss of the adrenal and parathyroid glands, as well as after section of the splanchnic nerves and other operative procedures. In our experience, this type of ulcer is always acute. If the animal survives the procedure, which was accompanied by the development of the ulcer, healing always occurs, and no trace of the lesion remains.

"The other type of ulcer is the one that we have observed more commonly. The conditions under which it develops are definite and limited. The ulcer is usually single, although two or, rarely, three (hardly more) ulcers may be present at one time. The site of the lesion is in the pathway of the outflow of gastric contents; it is never in the fundus. The exact site of its development is definite and constant. It starts on the surface of the mucosa as a grayish, circumscribed membrane. At first it is saucer-shaped, and later the usual appearance of peptic ulcer as seen in man develops. In the beginning the lesion is acute, but if perforation with peritonitis or fatal hemorrhage does not occur, it quickly becomes chronic. Grossly and microscopically, this type of lesion resembles peptic ulcer as found in man.

"Whether either of these two types of lesions corresponds to the type seen in man has not been determined, owing to the fact that the process of development of the lesion in man has not been determined. If the mucosal lesion in man which precedes the development of the characteristic chronic peptic ulcer begins as a hemorrhage into the submucosa, it would appear that many of the



results of our investigations would have little, if any, clinical bearing. . On the other hand, if the lesion in man begins at the surface of the mucosa, the type of lesion we have studied would appear to be the only type of experimentally produced ulcer that may be of clinical significance."

I believe that the acute type of ulcer which Mann and Bollman described is similar to the acute ulcerative lesions which Silberman produced in dogs after performing double esophagostomy and feeding a secretion of gastric juice obtained from the empty stomach by stimulating the secretory nerve. I believe that these acute ulcers and erosions described by Mann and by Silberman are the ulcers which Cushing found occurred following operations for cerebellar tumor. I do not think that this type of ulcer need be considered as simulating the chronic gastric or duodenal ulcer which is observed clinically.

The medical treatment of ulcer should be based entirely on these physiologic principles. Sometimes a great deal may be accomplished by employing a medical and dietary regimen similar to that originated by Doctor Sippy. If the patient responds satisfactorily, this plan of treatment may be continued. However, if the patient does not improve within a reasonable period of time, surgery should be undertaken. In our experience the various local operations and gastro-enterostomy have given very satisfactory results.

Endeavoring to utilize the principles of the experimental work that has been done and to apply them clinically, I have employed direct anastomosis of the stomach and duodenum for the past several years. I have done this because it seemed to me that this operation left the structures so that they could function more in accord with the normal physiologic processes than would be possible if other procedures were used. The stomach and duodenum can be anastomosed much more readily than formerly was presumed possible. This operation has been employed particularly by Wilkie, in Edinburgh, and the results have been most encouraging. I have carried out such an anastomosis in many cases of duodenal ulcer and have reason to think that a new ulcer will not form in the duodenum subsequently. I realize that this is not in accord with the results obtained by some others. However, my experience has encouraged me to continue to employ the operation in selected cases. I have not carried out resection of the stomach for benign ulcer of the stomach and duodenum except under exceptional circumstances. Furthermore, it seems to me that I shall not be inclined to do so, as the experimental studies indicate that the principles involved in the treatment of gastric and duodenal ulcer do not support the contention that resection of the stomach is often required for solution of the problem of ulcer.

DR. ALTON OCHSNER (New Orleans, La.).—We, too, have attempted to evaluate the effect of acidity in experimental production of ulcer in three groups of experiments. We have attempted to reproduce ulcer in the stomach and the first portion of the intestine, as Doctor Dragstedt has done in a series of experiments.

In one series we formed pouches from the greater and lesser curvatures of the stomach, respectively. Although the acidity in the individual pouches varied but little, the incidence of ulcer was much higher (63.6 per cent) in the lesser curvature pouches than in those on the greater curvatures (0 per cent). Following histamine injections we also found the incidence of ulceration much greater along the lesser curvature than elsewhere in the stomach. This, we believe, is due to the fact that the "magenstrasse" is more susceptible to ulceration than other portions of the stomach.

In a second group of experiments the lesser and the greater curvature



pouches, respectively, were anastomosed with the proximal jejunum. Jejunal ulcers developed in all (100 per cent) of the animals with the greater curvature pouch-jejunal anastomosis, whereas but 71 per cent of the animals with lesser curvature pouch-jejunal anastomosis developed ulcers. In another group of animals with lesser and greater curvature pouches, respectively, and jejunal anastomoses, bile was diverted into the pouch by anastomosing the gallbladder to the pouch and dividing the common duct. The ulcer incidence decreased in the lesser curvature pouch-jejunal anastomosis to 50 per cent and in the greater curvature pouch-jejunal anastomosis to 28 per cent.

In further experiments performed by Doctor DeBakey, in our laboratory, the relative protective influences of bile, pancreatic, and duodenal juices were determined. Pyloric occlusion and gastrojejunostomies, similar to those advocated by von Eiselsberg, were performed. Jejunal ulcers developed in 50 per cent of the animals. In addition to the pyloric occlusion operation the pancreatic juice was deviated away from the anastomotic site by anastomosing the pancreatic duct with the terminal ileum. The incidence of ulceration in this group was 70 per cent.

In another group the bile was deviated from the anastomotic site by anastomosing the gallbladder to the terminal ileum and dividing the common duct. Incidence of ulceration increased to 90 per cent. In animals with both the bile and pancreatic juice deviated from the anastomotic site the incidence of ulcer was 100 per cent. It may be concluded from these experiments that both bile and pancreatic juice are protective in preventing ulceration and that of the two bile is more protective than is pancreatic juice.

Based upon those experiments and our clinical observation, we feel that there are three factors in the production of peptic ulcer as follows: first, and probably the most important one from the standpoint of therapeutics, is increased acidity; second is tissue predisposition, and the lesser curvature of stomach is, as we all know, more susceptible to ulceration than other portions of the stomach. The third, and probably the most important etiologic factor is a predisposition to ulcer formation; *i.e.*, ulcer diathesis.

As regards therapy the best we can do is to control the acidity by diet and by the administration of antacids or by operation. All operative procedures should be of such a type as to decrease the acidity. We feel that in the patient with normal or hyperacidity gastro-enterostomy should not be done, because with the patient's ulcer diathesis the chances of developing a jejunal ulcer are even greater than developing the original ulcer, because the jejunal mucosa is less resistant to the acid gastric chyme than are the duodenal and gastric mucosa. A pyloroplasty which will permit regurgitation of the alkaline duodenal secretions more readily is much safer, but in some instances subtotal gastric resection will be necessary. From our experimental and clinical observations, however, we are convinced that the acceptance of the ulcer diathesis is essential and that for the life of the individual it is necessary for him to abstain from those things which increase gastric acidity, especially smoking and drinking of alcohol.

DR. HENRY F. GRAHAM (Brooklyn, N. Y.).—I would like to take exception to one statement made by Doctor Dragstedt, namely, the recommendation for a large opening in gastro-enterostomy. There are certain individuals who have a gastro-enterostomy, who are unable to eat large meals, especially those containing large quantities of fluid such as a dinner accompanied by soup and several glasses of water, without a great deal of discomfort and inability for

rapid emptying of the stomach afterward. I think there is a good mechanical reason for it.

If you have a large opening, and the stomach becomes distended, you get a flattening of the jejunum against the stomach and in that way it closes up the entire opening. I think it is possible to make too large an opening and thus cause trouble.

DR. J. SHELTON HORSLEY (Richmond, Va.).—It is quite necessary for surgery on any portion of the body, and especially on the stomach, to have a firm foundation on biologic facts. The observations of physiologists have taught us more about correct fundamental principles of gastric surgery than have the operating surgeons.

The etiology of peptic ulcers may be divided into three classes, or a combination of these classes: (1) hyperacidity, which Doctor Dragstedt has so well brought out; (2) toxic influences such as from burns or from certain types of streptococcic bacteria, which Rosenow has demonstrated; and (3) the neurogenic origin, which has been brought into prominence recently by Harvey Cushing. Doubtless in many instances some combination of these three causes may act to produce a peptic ulcer. The presence of hyperacidity, for instance, may be due to excessive vagus stimulation. The affinity of gastric cells for certain bacteria or toxic products may also cause hyperemia and probably hyperacidity.

An important fact that physiologists have shown is that the susceptibility of the gastro-intestinal mucosa to the acid of the gastric juice increases with the distance from the pylorus. Consequently, in a Billroth II type of gastrectomy, particularly if done for a gastric or duodenal ulcer with high acidity, we are apposing to the stomach a portion of the bowel that is more susceptible to irritation by the gastric juice than would be the duodenum. When the gastric acidity is low, as it usually is in cancer, the danger of jejunal ulcer is not so great, but it cannot be entirely eliminated for after the malignant lesion has been removed it may be that the acid secretion of the stomach will be resumed. That this is not solely a theory is shown by an interesting case reported by Dr. Fordyce B. St. John, of New York; he removed a cancer of the stomach and did a Billroth II type of operation. Later the patient died from a jejunal ulcer. It seems apparent that when a partial gastrectomy is indicated some type of Billroth I operation should be employed whenever it is possible to do so. There are ulcers in the duodenum not because the duodenum is more susceptible to the gastric juice, but because it receives the first impact of the acid.

Doctor Ochsner has shown in experiments that there is some protective influence of the bile against the formation of peptic gastric ulcers in experimental work on dogs, but this is not so great as the alkaline influence of the pancreatic juice. Bile is very slightly acid, or even neutral, whereas the pancreatic juice is very strongly alkaline. If the presence of bile, then, tends to lessen the incidence of peptic ulcer, it is probably due to some other cause than to its chemical reaction. In the interesting experiments of Doctor Ochsner a peptic ulcer occurred more frequently along the lesser curvature than the greater curvature. The factor of more active peristalsis along the lesser curvature than along the greater curvature should be taken into consideration. Peristalsis is initiated along the lesser curvature and ordinarily it is far more active in this region, whereas if the segment of the stomach comprising the greater curvature is isolated, much of the impulse for peristalsis has been obliterated. The more vigorous and constant action along the lesser curva-

ture, other things being equal, would seem to predispose to ulcer formation far more than in the quiet, inactive segment of the stomach.

DR. LESTER R. DRAGSTEDT (Chicago, Ill.).—It is not possible in the time allotted to give proper credit to the large amount of excellent experimental work on the cause of ulcer done both in this country and abroad. I should like to emphasize that there is nothing in our experiments which precludes the possibility that mechanical factors, such as the motility of the stomach or pylorus or the abrasive action of coarse food, or infection, may operate to delay the healing of an acute lesion and induce chronicity. However, I do believe that of all the factors likely to play a rôle in young and otherwise healthy adults (the people who get ulcers) the chemical action of the gastric content when it approaches the acidity of pure juice is the most important. The concentration of free hydrochloric acid is more significant than pepsin, and hence the term "acid ulcer" is more accurate than "peptic."

I am not convinced that the theory of Aschoff that the cause of prevalence of ulcer along the lesser curvature is the mechanical effect of food passing along the "canalis gastricus" is correct. We created such a canal experimentally in a dog with a large Pavlov pouch. The mucosa of the canal remained normal but an ulcer developed in the isolated pouch. There is no doubt that an acute lesion near the pylorus is more apt to become chronic than a similar one in the body of the stomach. We have a special case in the fact, I think, that such lesions produce spasm of the pylorus, cause retention, and so raise the acidity of the gastric content until it approaches the acidity of gastric juice. A pyloric lesion will do this to a normal secretory mechanism. There are other cases in which we find a hypersecretion of gastric juice, ill understood, perhaps, but without pyloric obstruction, and it is in these cases, I believe, that we find a large incidence of jejunal ulcer following operation, whether it be a gastro-enterostomy or partial resection.

The protective action of bile and pancreatic juice has been clearly demonstrated in experimental ulcer and has been of great significance in determining the importance of acid in the genesis of these lesions. This factor is of less importance in the clinical problem.

## FACTORS GOVERNING THE RESULTS OF SURGICAL TREATMENT OF DUODENAL ULCER

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THE results of the surgical management of duodenal ulcer are always somewhat difficult to evaluate because of the many factors upon which they depend. Figures from various clinics show a convincing uniformity (80 to 90 per cent) of satisfactory results brought about by operation when chronicity and failure of adequate medical management are the basis for advising operation. When such a practice is followed, surgical treatment not only accomplishes relief of the symptoms of ulcer and marked general improvement in health, but a remarkable control against recurrence of the disease and protection against the most serious complication of ulcer, namely, acute perforation, as well as a high protection against subsequent hemorrhage. Although such results may be gratifying in view of the chronicity which is characteristic of the disease and the fact that all other treatment has failed before surgery is instituted, I believe that the continued study of the circumstances under which satisfactory results follow operation should provide clues which will aid toward a better understanding of the fact that the efficiency of surgical treatment primarily rests on the proper: (1) selection of cases for operation; and (2) selection of the operation. The more accurate our knowledge in these respects, the more accurate will be the prognosis as to what results may be expected from surgical management.

This study of 1,086 consecutive cases of chronic duodenal ulcer, in which patients were operated on in the years 1927 to 1928 and who have been followed over a period of seven years or more, was undertaken with the above mentioned purpose in view. It may be noted that although the results were compiled for a minimum of seven years after operation, they do not necessarily imply that recurrences of the disease or its complications after this time may not take place; but, when patients have been perfectly well for this length of time, serious recurrences are so rare that they are usually considered worthy of special record.

The results following operation have been classified as either satisfactory or poor. In the group in which results were satisfactory two general types of cases were included: (1) those in which patients were completely relieved of symptoms, and in which no restrictions in diet were necessary; there was no interference with work, and the patients were in excellent general health, such cases comprising approximately 90 per cent of those classified as satisfactory; and (2) the remaining 10 per cent of cases, in which there was persistence of symptoms, as represented by occasional discomfort which could be controlled by temporary care in the diet, alkalies, and by a better

balance of rest and activity. The group in which results were considered poor included cases in which the patients were not relieved of symptoms, continued to be more or less disabled, were unable to carry on a normal routine of living, and in whom jejunal ulcer developed or who had recurrence or reactivation of the ulcer necessitating continued treatment or further operation.

In reviewing these cases it is interesting to note the influence of age on the results, for it was found in the group of patients less than 30 years of age that satisfactory results followed in 85.2 per cent of cases, while those patients aged 60 years or more at the time of operation obtained a satisfactory result in 94.0 per cent of cases. The probable explanation for the better results obtained with older patients is: (1) that the lesion is likely to be more chronic than in younger patients; and (2) that with advancing years gastric secretion normally diminishes in activity.<sup>1</sup> In so far as recurrence of ulceration is concerned, jejunal ulcer developed following gastro-enterostomy in 5.3 per cent of cases in which patients were less than 30 years of age, and in 3.1 per cent of the cases in which they were more than 60 years of age.

The incidence of duodenal ulcer is lower among women than men; and possibly, because of whatever reasons make this true, the results of operation are also better among women than men. It was found that regardless of the type of operation carried out, a higher percentage of women (93.2 per cent) than men (86.0 per cent) obtained satisfactory results. The incidence of jejunal ulcer was 4.0 per cent among men, while there were no cases of jejunal ulcer in women (234 cases).

A study of the relationship of gastric acidity to the results of all operations disclosed the fact that when a constant high acidity, 70 or more, is present at the time of the operation, in 82.4 per cent of cases relief of symptoms may be expected. On the other hand, when the acidity is 30 or less, 90.5 per cent of patients obtained relief.

If results are considered on the basis of the effectiveness of the various types of operations as related to gastric acidity and the relationship of gastric acidity to the results of the operation, there appeared to be less evidence to justify radical views on this particular question than was anticipated. For example, it has long been thought that gastro-enterostomy should be avoided if possible for the group of patients with high acidity and no obstruction; but the fact that gastro-enterostomy brought about satisfactory results in 86.6 per cent of such cases, and that this is only a slightly lower percentage of satisfactory results than those that follow gastro-enterostomy when there is low acidity (89.2 per cent), suggests that too much emphasis has been given the contra-indications to gastro-enterostomy for the group with high acidity. It is true that the incidence of jejunal ulcer is higher for the group with high acidity as compared to the group with low acidity (4.4 to 2.7 per cent), but this fact does not give much support for the general replacement of gastro-enterostomy in the former group by plastic operations on the pyloric outlet or by



partial gastrectomy. In cases of excision and reconstruction of the pylorus, or gastroduodenostomy without excision, the avoidance of a 4.4 per cent risk of jejunal ulcer is counterbalanced both by the fact that the symptomatic results of these types of operations are considerably less satisfactory in this group than those following gastro-enterostomy, and also by the fact that the incidence of recurrence or reactivation of duodenal ulceration following the operations is much greater than the incidence of jejunal ulcer following gastro-enterostomy. It is in this high acid group that the advantages of partial gastrectomy have been most emphasized by the proponents of the operation. It has been our experience, however, that the higher the acidity, and consequently, theoretically, the greater the indications for partial gastrectomy, the more difficult it is to bring about sufficient control of the acid-forming mechanism to justify the operation on this basis. Many reports are now available from those who advocate wide gastric resection in such cases, showing that the persistence of acidity after radical resection is as high as 44 per cent.<sup>3</sup> Moreover, recurrence of symptoms or of ulcer after partial gastrectomy is a much more serious problem with which to deal than that after gastro-enterostomy.

In studying the cases from the standpoint of complications prior to, or present at, operation, it was immediately obvious that because of the relief of the distress of an obstructed stomach, the most strikingly satisfactory results were obtained with those patients who had obstruction of the pylorus. The greater the obstruction the more positive the satisfactory results if any associated toxemia due to the obstruction was controlled, for then the risk of operation was low, even when the patient was in poor condition. In cases of very marked obstruction, the percentage of good results was 91.4 per cent.

The effect of gastro-enterostomy in cases of marked obstruction is well known, but a more important fact is that in the absence of obstruction, the satisfactory results following gastro-enterostomy over a minimum of seven years are only slightly lower, 89.7 per cent, than in cases in which the obstruction is marked, 91.4 per cent. The belief, therefore, that in cases without obstruction gastro-enterostomy should be avoided if possible, and that excision and reconstruction of the pyloric outlet should be chosen, has not been substantiated in this study. This last named procedure under such circumstances was followed by 80.4 per cent satisfactory results as contrasted with 89.7 per cent following gastro-enterostomy. As for gastric resection in this group, reports are not available as to the control of symptoms over a similar length of time after operation, but thus far it has been shown from certain continental clinics that there are persisting symptoms in between 10 to 20 per cent of cases.

It is difficult to evaluate the relationship of chronic and subacute perforation to results, since this complication varies so much in degree. However, the impression that better results were obtained in those cases in which extensive induration had occurred about the duodenum seemed to be borne out by this investigation. Possibly the greater severity of symptoms in cases of extensive perforation, and therefore the marked relief from these symptoms, may have been partly responsible for such an impression.

Hemorrhage from ulcer continues to present a most difficult surgical problem. It should be emphasized that in cases of hemorrhagic peptic ulcer, the mortality from hemorrhage itself has recently been shown to be considerably higher than was formerly thought. Statistics from various hospitals<sup>2</sup> have shown that the complication not only is a serious one, but not infrequently one that has a fatal outcome. A study of cases of hemorrhagic ulcer emphasizes the difficulty in evaluating the effect of the different forms of surgical management, since hemorrhage varies so in frequency, severity, and in the extent to which it is associated with other symptoms of ulcer. In this group of 1,086 cases studied, one or more hemorrhages had occurred prior to operation in 22.7 per cent of cases, and, judging by the history, the hemorrhagic character of the lesion was a considerable factor in advising operation. It has been stated, a supposition to which we have subscribed at the clinic, that protection against subsequent hemorrhage was greater if the lesion or lesions could be removed; but in this group of cases this was not substantiated, for it was found that the indirect operations afforded at least equal protection against recurrence of hemorrhage as do those operations which include a direct attack on the ulcer.

The explanation of this apparent discrepancy between good theory and actual practice is related to some extent to the fact that a satisfactory gastro-enterostomy brings about and maintains healing of single and multiple inflammatory processes in the duodenum, and that any recurrence of bleeding usually is due to a superficial erosion which heals readily because of the gastro-enterostomy.

Although excision of the lesion and reconstruction of the pyloric outlet, or gastric resection of the Billroth I type, for hemorrhagic ulcer are theoretically and physiologically sound, these operations do not give as great protection against subsequent hemorrhage as do gastro-enterostomy or partial gastrectomy by the Billroth II method or its modifications. This probably is due to two facts: (1) that the former procedures do not always permit satisfactory excision of small concealed lesions; and (2) maintaining continuity of the stomach and duodenum apparently carries with it certain disadvantages in respect to reactivation and recurrence of inflammatory processes. The incidence of jejunal ulcer is so small when gastro-enterostomy is carried out on proper indications that excision and reconstruction, done primarily to avoid jejunal ulcer in these cases of hemorrhage, are not justified except in those in which the liability to jejunal ulcer is known to be high because of conditions already suggested.

In the Billroth II type of operation, any recurrence of hemorrhage almost certainly is caused by jejunal ulcer or jejunitis, since complete exclusion of the duodenum itself is extremely rarely followed by reactivation of any unremoved lesion in the duodenum or development of a new lesion at that site.

In spite of the fact that gastro-enterostomy by actual figures seems to be almost as effectual a means of protection in bleeding types of duodenal ulcer, theoretically the Billroth II operation, or one of its modifications, would give

## DUODENAL ULCER

the fewest recurrences. However, the Billroth II operation has the disadvantages of a much higher primary risk (particularly if a thorough resection is done of the involved part of the duodenum) and of failing to protect absolutely against recurrence of ulceration. Such facts will always emphasize the advantages of conservative procedures. In view of the information derived from this group of cases it would seem that the most reasonable management of the bleeding type of duodenal ulcer would be thorough local excision, if feasible, combined with a large gastro-enterostomy.

If the data obtained from this study are correlated, it is apparent that, in general, the best results, in so far as relief of symptoms is concerned, are obtained for patients (particularly women) of middle age, with impaired motor function, low acidity, and a long standing history of distress. Less satisfactory results are obtained, regardless of operation, the farther conditions are in opposition to the factors above mentioned; but this particular series of cases gives surprisingly little emphasis to this point. In respect to the value of the different types of operations, this study showed conclusively that if results are computed over a sufficient length of time after operation, and surgical management has been well applied according to the circumstances in each case, the conservative operations present so many advantages that they are the operations of choice for chronic duodenal ulcer, both with and without complications. In particular, the value of gastro-enterostomy clearly is apparent, for not only does it usually bring about complete and permanent healing of duodenal ulcer, but in the event of recurrence of ulceration in the stomach or jejunum it is the only operation which permits restoration of normal continuity of the stomach and duodenum, an advantage which it is unnecessary to emphasize.

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## THE POSSIBILITY OF MALIGNANCY AS IT AFFECTS THE TREATMENT OF CHRONIC GASTRIC ULCER

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THE chronic ulcer in the stomach may prove to be malignant, thereby differing significantly from the similar lesion in the duodenum. This is no newly discovered fact but has long been common knowledge. Its practical implications for treatment, however, are almost universally neglected. The history, the physical findings, all laboratory tests, the roentgenographic examination, the appearance at operation, even occasionally the histologic section may fail to differentiate the benign from the malignant ulcer of the stomach. There has been a controversy extending now over more than 50 years as to whether such malignant ulcers masquerading as benign in appearance usually arise as the degeneration of a preexisting, benign ulceration, or are carcinomata from their inception.<sup>1</sup> In 1927, I reviewed the evidence in the literature concerning this relationship of carcinoma and callous gastric ulcer<sup>2</sup> and concluded that the important point for the clinician and for the patient was not the academic one, which had been chiefly debated, as to what percentage of benign ulcers become malignant, but was the very practical one that many of the lesions which appeared clinically as simple ulcers proved eventually to be malignant. Refined methods of study, particularly the more exact investigation of the secretory activities of the stomach<sup>3</sup> and refinements in roentgenographic examination of the gastric pattern and activity,<sup>4, 5</sup> still fail to solve this problem in differential diagnosis. Thus Gray and Balfour,<sup>6</sup> in studying a large group of resected carcinomata, report that in 30 per cent of cases the roentgenologist had been unable to decide that the lesion was malignant and in ten per cent more had called it benign. In spite of an intensive search for some method of demonstrating when an ulcer is malignant, it is admitted almost universally by all competent clinicians that there is no such absolute criterion available. Consequently the individual instance of chronic gastric ulcer should be regarded at first as a possible malignancy no matter how long the history nor how benign the appearance of the lesion. Let me illustrate this diagnostic difficulty with three cases.

### CASE REPORTS

CASE I.—C.H.B. SMH. 4368. Male, aged 66, had had typical ulcer pain for 12 years always relieved by food and soda. In his last exacerbation of symptoms (two months) the pain has come a little sooner after eating but otherwise has been the same. No weight loss. P.E.—Negative. Lab.—Gastric analysis: Fasting, 18 per cent free HCl, 46 per cent total; increased to 52 per cent free and 76 per cent total after Ewald test meal. Stool—guaiac negative. Hemoglobin, 80 per cent.

## MALIGNANCY AND GASTRIC ULCER

Roentgenologic examination.—Typical penetrating ulcer niche  $1\frac{1}{2}$  cm. broad and 1 cm. deep sharply outlined on the lesser curvature at the angulus.

Preoperative and postoperative diagnosis.—Chronic gastric ulcer. Nothing to suggest malignancy.

Operation.—Subtotal gastrectomy.

Histology.—Showed typical appearance of benign ulcer with scar tissue base separating the muscularis without any evidence of malignancy in sections through the center of the ulcer. In one section at the edge of the ulcer there is typical adenocarcinoma extending from the mucous membrane and invading the muscularis and a limited small area of the scar tissue base at that one point only.

This case was reported in detail together with the histologic evidence in *Surg., Gynec. and Obst.*, vol. 46, p. 199, 1928. It is apparently a typical example of carcinoma developing in the edge of a preexistent benign ulcer. Nothing in either the clinical data or laboratory and roentgenologic studies suggested the presence of malignancy. The patient has remained entirely free of gastro-intestinal symptoms and without evidence of recurrence, now over eight years.

CASE II.—F.T.F. SMH 63871. Female, aged 46. P.I.—Typical ulcer pain, two to three hours after meals together with persistent night pain; six months' duration. P.E.—Tenderness over the pyloric region. Lab.—Red blood cells, 4 mil. hemoglobin, 75 per cent. Gastric analysis—not done on account of lack of cooperation of the patient. Stool—guaiac negative.

Roentgenologic examination.—G. I. series showed irregularity of the cap with local tenderness over it.

Course.—Day pain cleared up quickly on Sippy regimen. Night pain disappeared more gradually, following which the patient was discharged from the hospital. Pain recurred on an ambulatory ulcer regimen in two months and on this account she was readmitted to the hospital for operation.

Preoperative diagnosis.—Duodenal ulcer. Postoperative diagnosis.—Gastric ulcer.

Operation.—The ulcer proved to be on the gastric side of the pylorus, was 1.5 cm. in diameter, sharply circumscribed and non-indurated. The ulcer seemed so innocuous the surgeon operating was sure it was benign. Consequently he excised the ulcer with a liberal wedge and posterior gastro-enterostomy was performed. The lesion proved microscopically to be malignant in spite of its non-indurated character. The patient was strongly advised to be reoperated upon but subtotal gastrectomy was refused. She had an obvious recurrence in the epigastrium, which was verified on exploration 13 months after the first operation.

CASE III.—P.W. SMH 21096. Male, aged 21. First seen in 1929 with rather vague ulcer pain and roentgenologic evidence not conclusive but suggesting duodenal ulcer. He was at that time put on an ulcer diet and promptly became free from symptoms. He was readmitted in December, 1931, with the characteristic history and physical evidence of a ruptured ulcer.

Preoperative diagnosis.—Ruptured ulcer, probably duodenal.

Operation.—Ulcer was found on the lesser curvature of the stomach about one inch proximal to the pylorus. It showed a free perforation about one cm. in diameter with the indurated area sharply circumscribed to the region of the ulcer. It was closed by inversion. The operator entertained no question that the ulcer was anything but benign.

Course.—Symptomatic relief for two years followed by recurrence of moderate ulcer pain and occasional vomiting not of sufficient severity to bring the patient back to the clinic. Readmitted (second time) in January, 1934, on account of major hemorrhage from the ulcer (melena). Red blood cells had fallen to 3.4 mil. The patient had no pain and rapidly regenerated his blood on a conservative regimen.

Operation.—One month after hemorrhage subtotal gastrectomy was carried out. The scar of the perforated ulcer was identified at operation by the black silk sutures encapsulated in its peritoneal surface. Continuous with this healed scar, extending downward



on the posterior surface, was an ulcerated area about 3 cm. in diameter surrounded by a larger zone of induration (Fig. 1). While there was nothing pathognomonic about the ulcer, its size and the extent of the induration about it suggested the possibility of malignancy. Microscopically the ulcer was definitely malignant though the scarred area which had originally perforated was uninvolved.

These examples are chosen from a number of others that would equally well illustrate the impossibility of differentiating certain malignancies from benign chronic gastric ulcers on the basis of clinical examination, laboratory findings, or roentgenologic studies. On the other hand, however, many gastric ulcers respond favorably to medical treatment and never require operation. In order to harmonize, for therapy, these two conflicting tendencies in gastric ulcer, it was necessary to develop a clinical test for malignancy. Following the method of Jordan and Lahey<sup>7</sup> those gastric ulcers not having definite malignant stigmata are satisfactorily divided into two main groups by their response to a short period of medical treatment.

## CHART I

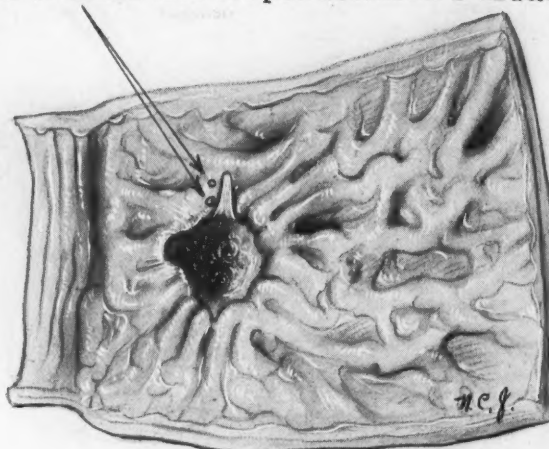
## CLINICAL TEST FOR MALIGNANCY IN CHRONIC GASTRIC ULCER

By response to rigid medical treatment			
Within		Group A	Group B
1 week	Improvement in symptoms	+	—
2 "	Practical disappearance of symptoms	+	—
2 "	Disappearance of occult blood in stools	+	—
3 "	Marked decrease in size of ulcer niche (at least $\frac{1}{2}$ )	+	—
After 3 weeks	Continuous decrease of ulcer to disappearance (checked by X ray)	+	—
Any time on treatment	Recurrence of symptoms or Increase in ulcer niche		+

By the use of this clinical test for malignancy, the gastric ulcers are divided into two groups at the end of not over three weeks' time. These do not represent complete separation of pathologic entities but they serve as a basis for the choice of therapy. In the first group where the response to the test is not only by symptomatic relief but also by marked decrease in the size of the lesion, medical treatment should be continued, checked carefully, however, by roentgenologic studies, until it is proved that the niche has completely disappeared. The patients in the second group where the response is unsatisfactory or incomplete should be operated upon at once (Chart I).

The two following cases illustrate the typical difference in reaction of two examples, one falling in each of the groups. The cases originally were very similar, both in the cancer age, the location, size and appearance of the niche being not unlike, and neither had free HCl in the fasting contents but both showed it after an alcohol test meal. Yet the response of these two cases was entirely dissimilar and indicated in the one case the continuation of medical

Location of silk ties on peritoneal surface



Section of stomach

1 cm. 2



FIG. 1.—Case III. P. W.—Appearance of ulcer at resection. The position on the peritoneal surface of the silk ligature marking the site of the ruptured ulcer two years previously is indicated on the drawing. At the first operation there was nothing to suggest malignancy.

treatment, in the other immediate radical surgery which has given this patient a chance for cure of a carcinomatous ulcer.

CASE REPORTS

CASE IV.—R.S. SMH 96388. Male, aged 50. Typical ulcer pain coming two hours after meals associated with black stools; duration three weeks. Ten pound weight loss. P.E.—Moderate emaciation, tenderness on deep pressure in midepigastrium. Lab.—Red blood cells, 3.5 mil. Stool—guaiac negative. Gastric analysis, fasting, 0 free HCl, 22 per cent total. After alcohol test meal, 20 per cent free HCl, 36 per cent total.

Roentgenologic examination.—Large ulcer niche (3 cm.) high on lesser curvature (Fig. 2).

Preliminary diagnosis.—Gastric ulcer, possibly malignant.

Course.—Satisfactory response to test period of medical treatment (Figs. 3 and 4). Asymptomatic on ambulatory ulcer regimen at present.

CASE V.—C.A. SMH 85305. Male, aged 62. P.I.—Typical ulcer pain three to four hours after meals completely relieved by soda, incompletely by food; duration seven months. P. E.—No abdominal masses or tenderness. Lab.—Gastric analysis—fasting contents no free HCl, after alcohol test meal free HCl present. Stool—guaiac negative.

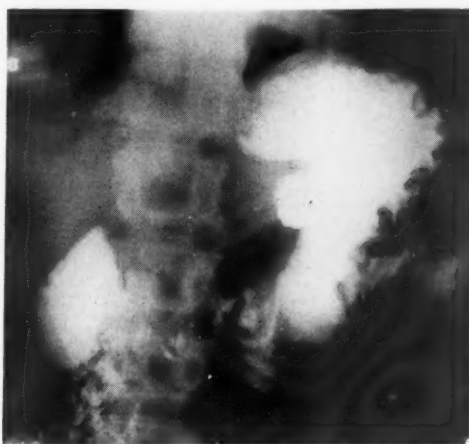


FIG. 2.—Case IV. R. S.—Large ulcer niche on lesser curvature.

Roentgenologic examination.—Large ulcer (3 cm.) on lesser curvature of stomach (Fig. 5).

Course.—Ambulatory ulcer diet prescribed at first visit in out-patient department (before the roentgenologic examination had been obtained), gave complete symptomatic relief within five days. On repeating the roentgenography at the end of three weeks,

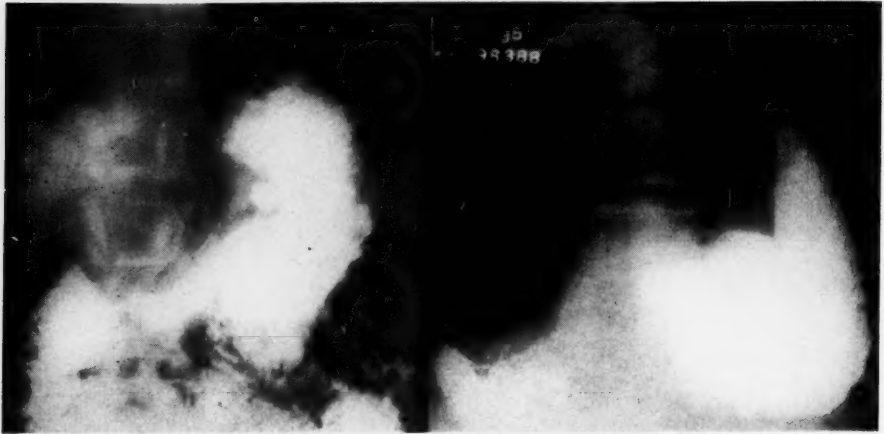


FIG. 3.—Case IV. R. S.—Significant decrease in size three weeks later.

FIG. 4.—Case IV. R. S.—Complete disappearance of niche six weeks later than Fig. 3.

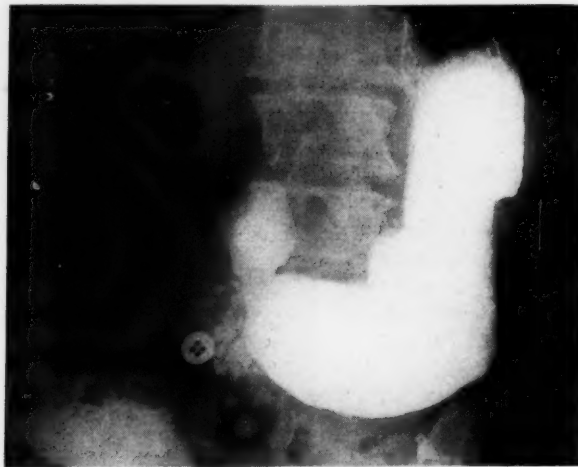


FIG. 5.—Case V. C. A.—Large ulcer niche at angulus on lesser curvature. No striking decrease in size after three weeks in spite of complete symptomatic relief.

however, there was no significant decrease in the size of the niche. Consequently this patient falls in Group II and prompt operation was urged upon the patient. Due to the fact that the patient was symptom-free, he resisted this advice, but through pressure on the patient through the family, operation was accepted.

Preoperative diagnosis.—Gastric ulcer, probably malignant.

Operation.—Subtotal gastrectomy. Grossly the lesion was an ulcer, not certainly malignant (Fig. 6). Microscopic examination showed a carcinomatous ulcer. The patient is now symptom-free one year after operation.

Thus the clinical test saves us from operating for lesions that respond like that in Case IV. In most such patients, ulcer symptoms will continue to be held in abeyance and on repeated roentgenologic examination the appearance of the stomach will be found to be normal. Probably such lesions are represented by the healed small scarred areas covered with thinner epithelium that have been reported as found repeatedly in the stomach during routine autopsy examinations. Occasionally symptoms will recur during treatment in one of these cases that originally responded satisfactorily. The lesion then immediately becomes a carcinoma suspect and is treated as such. In the sec-

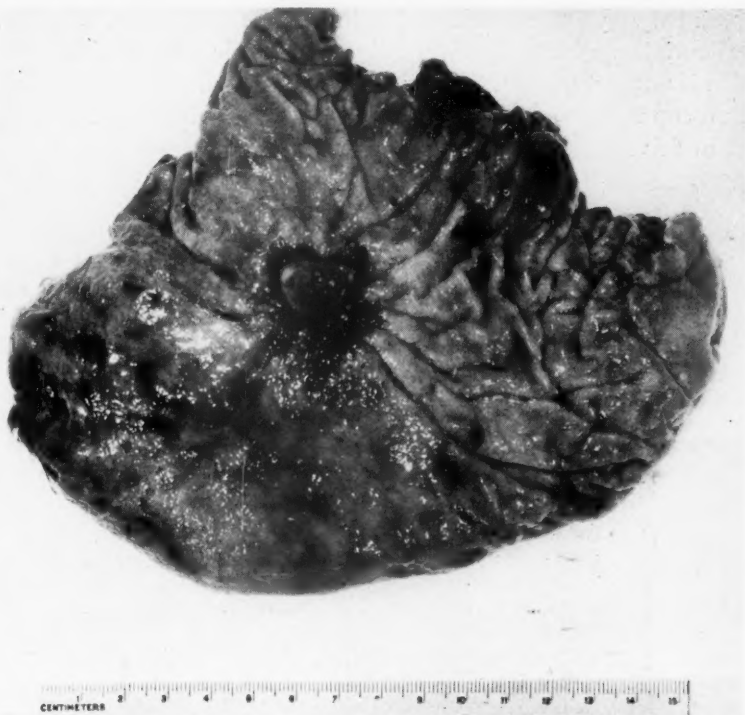


FIG. 6.—Appearance of ulcer on resection; no definite evidence of malignancy grossly.

ond group where the response to treatment is unsatisfactory or incomplete either symptomatically or by roentgenologic examination, many, though not all, of the lesions will prove histologically to be malignant. For this reason we treat radically the lesions in the second group, carrying out subtotal gastrectomy no matter how innocent such an ulcer may appear at operation. The local excision of these ulcers without including the lymph node bearing area is irrational and in our experience has usually resulted in recurrence when the ulcer proved to be malignant, as in Case II. We are convinced that the chronic gastric ulcer in the stomach chosen for operation on the basis of its incomplete response to a short trial period of medical treatment should be dealt with exactly as if it were known to be carcinomatous.

The second major way in which the possibility of malignancy should affect the treatment of gastric ulcer is in the opposite direction. It has been well established that the large gastric ulcer over two and one-half to three cm. in diameter is particularly likely to be malignant.<sup>8</sup> Although the exponents of this proposition never claimed more than a high degree of probability for it, many clinicians, in fact most of us, when confronted in the consulting room or at the operating table by a huge callous gastric ulcer, automatically tend to assume that there is little chance of its being benign. In our material of over 200 cases presenting themselves clinically as ulcers, the differentiation between a malignant and a benign lesion frequently has proved equally impossible in the very large ulcer as it has in the case of the smaller lesion. The practical corollary of this fact is that too pessimistic a view of the nature of the lesion is unwarranted on the basis of size until malignancy is proved under the microscope. I should like to offer the evidence of the following cases in support of this statement.

#### CASE REPORTS

CASE VI.—A. deM. SMH 36881. Male, aged 46. P.I.—Typical ulcer pain eight years' duration. Melena with symptoms twice during this time. Forty pound weight loss in the last year. P.E.—Emaciation, visible peristalsis over stomach. Lab.—Red blood cells, 4.5 mil. Hemoglobin, 85 per cent. Stool—guaiac negative.

Roentgenologic examination.—Huge ulcer niche high on lesser curvature of the stomach with formation of an accessory pocket (3½ cm. across the neck of the defect, 5½ cm. across the widest point) (Fig. 7).



FIG. 7.—Case VI. A. deM.—Huge ulcer high on greater curvature.

relief by food and soda—three years' duration. Questionable melena several times. Attacks of vomiting. P.E.—Moderate emaciation. Point tenderness right epigastrium. Lab.—Red blood cells, 4.5 mil. Stool—guaiac positive. Gastric analysis—fasting; no free HCl, 25 per cent total. After histamine; 70 per cent free, 92 per cent total.

Roentgenologic examination.—90 per cent six hour gastric residue. Large ulcer niche on lesser curvature (3 cm. in diameter).

Preoperative diagnosis.—Gastric ulcer—questionably malignant.

Operation.—Subtotal gastrectomy. Induration extended down from the ulcer to

Course.—Favorable response to treatment with reduction of the enormous defect to a minute "V" shaped one with relief of symptoms for five months (Figs. 8, 9 and 10). Recurrence of symptoms and increase in the niche (Fig. 11).

Preoperative diagnosis.—Gastric ulcer, benign, probably with adherent ulcer base.

Operation.—Subtotal gastrectomy. Ulcer base found adherent to liver and pancreas. Microscopic examination showed a benign gastric ulcer.

Course.—Symptom-free since operation four years ago.

CASE VII.—A.B. SMH 64199. Male, aged 53. P.I.—Ulcer pain with

Questionable hematemesis once. Questionable melena several times. Attacks of vomiting. P.E.—Moderate emaciation. Point tenderness right epigastrium. Lab.—Red blood cells, 4.5 mil. Stool—guaiac positive. Gastric analysis—fasting; no free HCl, 25 per cent total. After histamine; 70 per cent free, 92 per cent total.



# MALIGNANCY AND GASTRIC ULCER

involve the pylorus. While the lesion grossly suggested malignancy, the histologic sections did not bear this out. The patient was symptom-free at last report a year after operation.

CASE VIII.—J.T. SMH 76173. Male, aged 52. P.I.—Ulcer pain five weeks' duration. No symptomatic relief from strict medical regimen in bed. Two episodes of similar pain 15 and 30 years ago. P.E.—Tenderness in epigastrium. Lab.—Hemoglobin, 95 per cent. Stool—guaiac strongly positive. Gastric analysis—fasting, 18 per cent HCl, 33 per cent total.



FIG. 8.—Case VI. A. deM.—Marked reduction in size after two weeks' treatment.

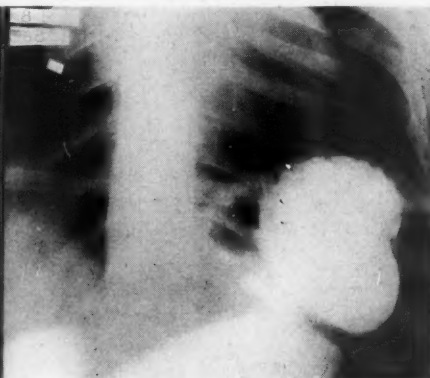


FIG. 9.—Case VI. A. deM.—Size after four weeks' treatment.

Roentgenologic examination.—Moderate six hour residue with large flat ulcer niche (4 cm.) on lesser curvature of the stomach at the angulus (Fig. 12).

Preoperative diagnosis.—Gastric ulcer—probably malignant.

Operation.—Subtotal gastrectomy. At operation the lesion was thought to be probably malignant but histologic section showed it to be benign. Patient has been asymptomatic since operation.



FIG. 10.—Case VI. A. deM.—Six weeks after treatment the niche had been reduced to a small "V."

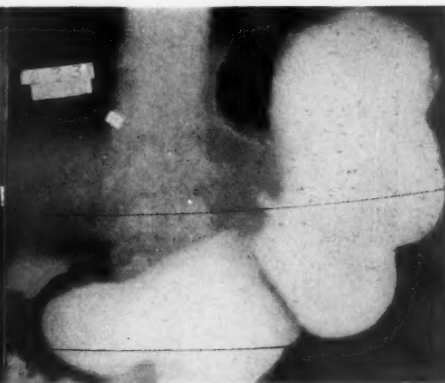


FIG. 11.—Case VI. A. deM.—Six months later than Fig. 10 while still on treatment the small "V" shaped defect began to become dumb-bell shaped again with the recurrence of ulcer symptoms. Resection was easily carried out in this stage before the ulcer had become large again.

CASE IX.—G.W. SMH 28218. Male, aged 55. P.I.—Gastric obstructive symptoms with pain unrelieved by food or soda; five months' duration. Recent vomiting with

coffee ground material. P.E.—Tenderness and mass in right epigastrium. Lab.—Hemoglobin 95 per cent. Stool—tarry, guaiac positive. Vomitus—guaiac positive with free HCl.

Roentgenologic examination.—One-third residue at six hours. Irregularity in outline of pyloric end of stomach.

Preoperative diagnosis.—Carcinoma of stomach.

Operation.—Subtotal gastrectomy. A very large ulcer occupied practically the whole

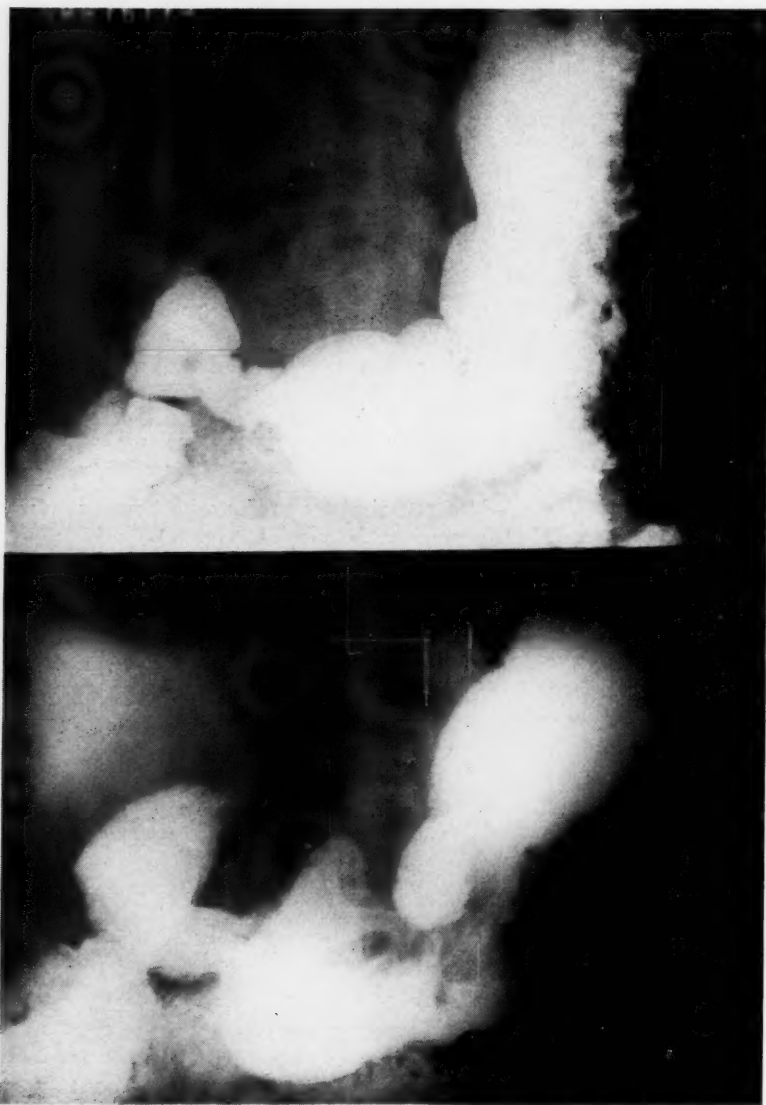


FIG. 12.—Case VIII. J. T.—Large flat ulcer niche on lesser curvature extending on to the posterior wall of the stomach.

of the posterior wall in the pyloric end of the stomach past the angulus (Fig. 13). In spite of its tremendous size, sections taken from all parts of this lesion failed to show any carcinoma. The patient has remained free of symptoms since operation six years ago.

CASE X.—W.C. SMH 65255. Male, aged 55. P.I.—Pain in left epigastrium

## MALIGNANCY AND GASTRIC ULCER

three and one-half years' duration. This has almost completely incapacitated him for one and one-half years. No relief of pain on ulcer regimen. Major hemorrhage (hematemesis and melena), hemoglobin, 44 per cent. Thirty pound weight loss. P.E.—Emaciation. Tenderness in midepigastrium.

Lab.—Hemoglobin, 90 per cent. Stool—benzidin negative. Gastric analysis—fasting; no free HCl, 13 per cent total. After alcohol test meal; no free, 18 per cent total. After histamine; 32 per cent free, 48 per cent total.

Roentgenologic examination.—Huge deforming ulcer on posterior wall of the cardiac end of the stomach (5 by 3½ cm.), the deformity reaching the greater curvature (Fig. 14).

Preliminary diagnosis.—Gastric ulcer—questionably malignant.

Operation.—Gastrectomy.—(two stage) with anastomosis of the esophagus to the jejunum. The operation was carried out in two stages, the amount of induration (into the pancreas) with the enlargement of the lymph nodes along the aorta and about the cardia made it seem almost certain that the lesion was malignant. Biopsy of one of these nodes

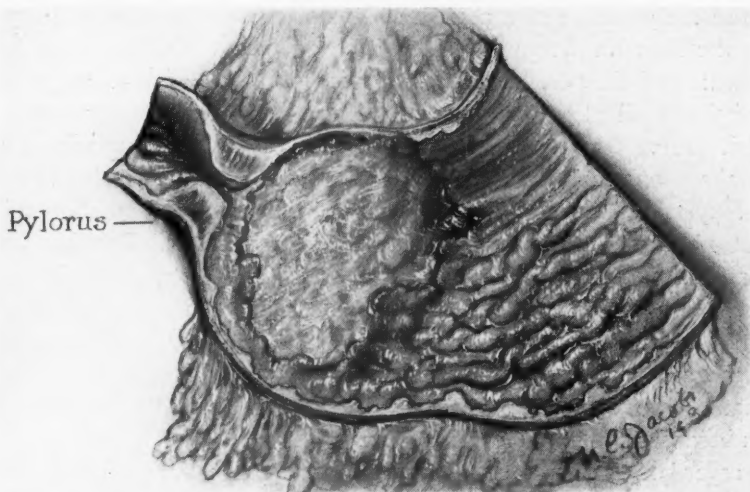


FIG. 13.—Case IX. G. W.—Huge ulcer involving nearly all of the posterior wall of the pyloric antrum.

removed in the first stage was not found to contain cancer. Consequently the lesion was removed at a second stage with an excellent exposure of the cardia by chondroplastic resection of the costal margin. All of the stomach was removed except the pylorus and prepyloric antrum. The patient has been free from symptoms since operation (three years).

It seems, then, that many chronic gastric ulcers which by their size and other clinical characteristics suggest malignancy are found actually to be benign lesions. The lesson for the surgeon in this is that radical cure of these large ulcers when they do not respond to medical treatment should be attempted if definite evidence of metastasis or extension is lacking.

### DISCUSSION

Case I is definitely carcinoma *ex ulcere* and apparently Case III is also a malignant ulcer which developed as the direct continuation from a perforated benign ulcer. We do not have evidence of the histologic structure of this ulcer at the time of perforation, but it healed with normal scar for-

mation and without carcinoma in its base. This is the only ulcer in our series which perforated freely, at operation appearing to be a simple benign perforated ulcer, but which subsequently developed the characteristics of malignancy. Usually we consider the punched-out simple perforated ulcer as a benign lesion both at the time of operation and also in its potentialities. We do not resect such lesions. This case demonstrates, however, that even such apparently benign lesions have to be kept under observation for malignancy. It was only in conformity with our rule that all gastric ulcers are treated by radical resection if symptoms recur that this patient was operated upon after he had recovered from the immediate effects of hemorrhage.

The second case is an excellent illustration of the prepyloric ulcer. Upon roentgenologic examination on two occasions this lesion was considered to be on the duodenal side of the pylorus due to the absence of any characteristic niche and the presence of a persistent irregularity of the duodenal cap. On finding the ulcer on the gastric side of the pylorus, the surgeon should have been warned of the possibility of malignancy in spite of the benign appearance of the small ulcer. Holmes and Hampton<sup>9</sup> have recently stressed the fact that the vast majority of the ulcers proximal to the pyloric canal but within about one inch of it are malignant. Finsterer<sup>10</sup> has also urged that such prepyloric ulcers should receive special attention. In addition this case illustrates how unsatisfactory is local excision of the ulcer. Possibly the same rapid recurrence would have followed subtotal gastrectomy in this case, but at least we could feel that everything possible had been done for the patient. Our rule in regard to resection by subtotal gastrectomy was broken in this case because the operating surgeon was so sure that the ulcer was not malignant. Particularly in the prepyloric region, this rule should never be broken because the lesion looks innocent.

In regard to the use of a trial period of treatment, we adopted this procedure in order to avoid operation in those cases that respond well to medical treatment. Symptomatic relief alone, however, is by no means a satisfactory guide but must be accompanied by a striking decrease in the size of the ulcer niche as demonstrated by roentgenologic examination. This fact cannot be too strongly emphasized and is not sufficiently recognized. A recent author,<sup>11</sup> in summarizing the clinical considerations of gastric ulcer and carcinoma, stated "in early carcinoma, medical treatment rarely abolishes pain." This is distinctly not in agreement with our experience in the early cases and we feel sure that if symptomatic relief alone is used as a criterion, many patients with malignant ulcers will be thought to respond satisfactorily. For example, Case V on an ambulatory dietary treatment was completely relieved of pain before his roentgenologic studies were available at his second visit (five days after starting treatment). Patients with frank carcinoma producing a large filling defect often get symptomatic relief for several weeks and may gain as much as 25 pounds in weight when put on an ulcer regimen. Such dependence on the symptomatic effect of treatment for its guidance has been one of the important factors in delaying the earliest possible resection of ulcer-mimicking

carcinomata of the stomach. Some surgeons find fault with a trial period of treatment as causing a delay in operating on those ulcers which prove after resection to be malignant. In 1927 we advised operation for all callous gastric ulcers.<sup>2</sup> Such a policy, however, is too drastic as it submits to operation many ulcers that will respond satisfactorily to medical treatment. We still advise *immediate* operation for all ulcers in the stomach which present strongly suggestive evidence that the lesion is malignant. However, the size of the ulcer alone, the absence of free hydrochloric acid, the association of pyloric obstruction, moderate loss of weight and strength, are not in themselves such criteria of malignancy as they are found in many benign ulcers. The prepyloric ulcer, the ulcer on the greater curvature of the stomach and the ulcer showing roentgenologic characteristics of malignancy<sup>5</sup> should be explored immediately without being submitted to such a test period. Ulcers on the lesser curvature of the stomach which have not been given a brief trial of medical treatment, however, should have this test. Usually the period need not be over three weeks in length; often it may be considerably less than this. In the by and large, if we could get the whole medical profession to carry out such a clinical trial at the first moment when they see a new case of gastric ulcer, we would save, on the average, many weeks of valuable time in arriving at operation in these carcinomatous ulcers.

Case VI illustrates very well the diagnostic import of the accessory pocket in the ulcer niche. Carman<sup>12</sup> called attention to the fact that no matter how large an ulcer niche is, when it perforates the stomach wall with the formation of an accessory pocket the lesion is seldom malignant. An ulcerating carcinoma often breaks through the gastric wall and may attach itself to adjacent tissues but in such a situation usually a filling defect or irregularity in the vicinity of the ulcer margin suggests the presence of neoplasm.

Whipple and Raiford<sup>13</sup> have given us an important correlation between the gross tumor type and the prognosis in gastric carcinoma. They make the point that malignant lesions with an ulcer story followed by a change in the symptoms are usually of the infiltrating, highly malignant type and therefore operation is indicated at once. Consequently it is very important to detect the character of these lesions before they have reached this stage. I believe that the management outlined for ulcers which fail to respond completely to a short test period of medical treatment or whose symptoms recur on treatment will call attention to such lesions in the earliest possible stage.

Some who still doubt the frequency and importance of malignant ulcers in the stomach, clinically indistinguishable from benign lesions, point to results such as those reported by Balfour,<sup>14</sup> following gastro-enterostomy without removal of the lesion. He found in 100 cases, where the ulcer was not removed and the patient was followed for five years or more, only six instances of death from gastric carcinoma. On analyzing these results, however, in the light of the selection of these patients as explained by Balfour, it is apparent that the method of choice automatically included those lesions, chiefly from the posterior wall of the stomach, the upper half of the lesser



curvature and the cardiac end of the stomach where the proportion of malignant ulcers is particularly low and excluded ulcers of the pyloric antrum and the greater curvature, locations where there is a greater likelihood of malignancy among questionable lesions. Therefore by this process of selection, an incidence of 6 per cent of carcinoma is not surprising at all.

The last case illustrates a technical maneuver of some value in approaching the cardiac end of the stomach. When the costal angle is relatively narrow, it may be very difficult indeed to expose the cardia of the stomach. By carrying out chondroplastic resection of the costal margin (Figs. 15 and 16), an excellent exposure of the cardia is obtained. This method of exposure of structures just beneath the left diaphragm was first reported in this country by

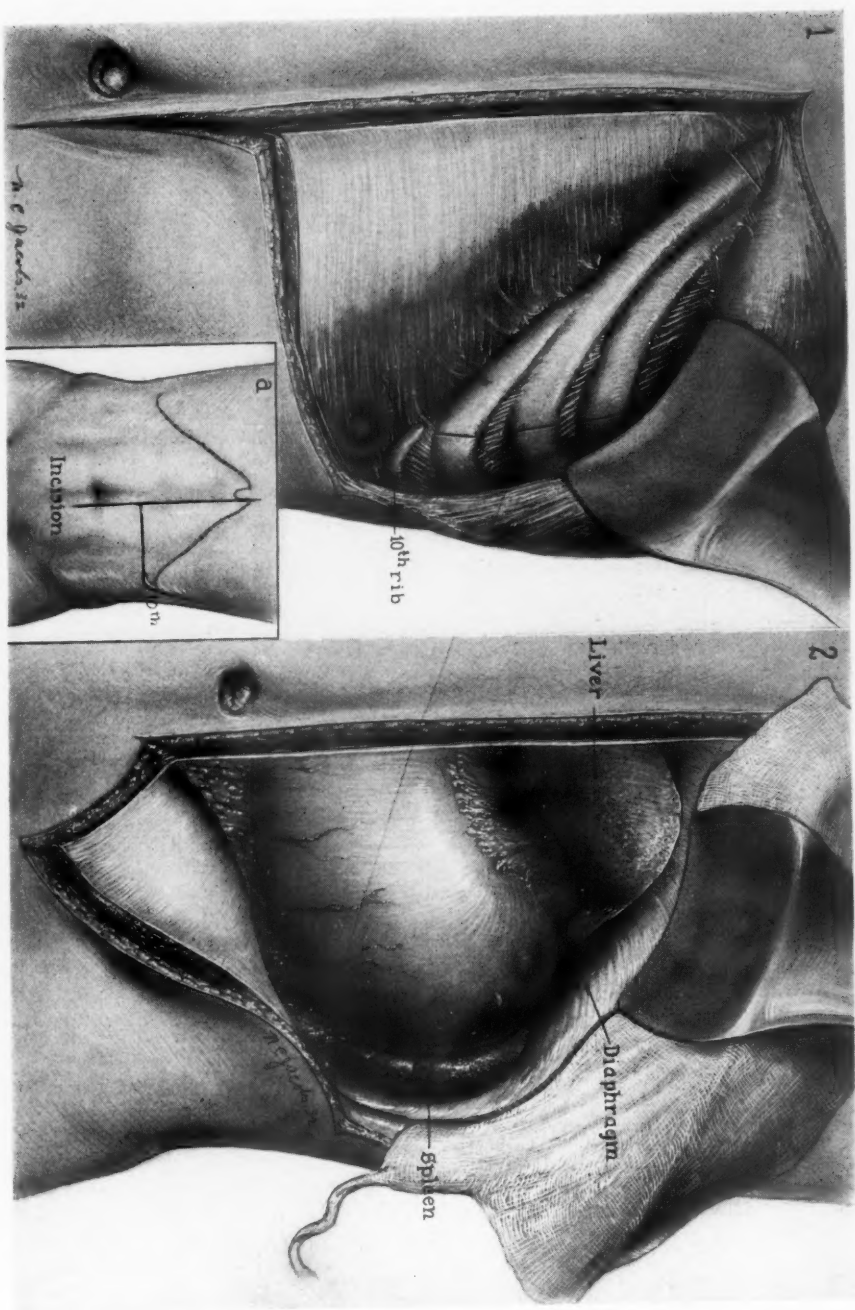


FIG. 14.—Case X. W. C.—Huge deforming ulcer on the posterior wall of the cardiac end of the stomach reaching the greater curvature.

Willy Meyer, Sr.,<sup>15</sup> in 1906, and has recently been made readily available in the literature by his son.<sup>16</sup> It was of very real technical advantage to us in this case and enabled us to remove with comparative ease a lesion the exposure of which would have been extremely difficult without its aid.

#### CONCLUSIONS

It is impossible to differentiate with certainty between many of the malignant and the benign ulcers in the stomach. This fact has two practical implications for treatment: (1) unless a gastric ulcer responds promptly and completely to a therapeutic test period, not only by symptomatic relief but also in the size of the roentgenographic niche, it should be removed at once in the same radical manner that known carcinoma is treated, *i.e.*, ordinarily by subtotal gastrectomy. (2) Huge gastric ulcers showing no other stigmata of malignancy are frequently benign, and, if refractory to a short test period of medical treatment, they should be attacked surgically for cure.



Figs. 15 and 16.—Chondroplastic resection of costal margin giving excellent exposure.

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DISCUSSION.—DR. E. STARR JUDD (Rochester, Minn.).—I think we all agree with Doctor Scott that experience has taught that there is no certain method of distinguishing benign from malignant gastric ulcer either before operation or from the gross appearance of the lesion at operation. With present methods of investigation it is usually not difficult to arrive at a diagnosis of "carcinoma or ulcer," but to distinguish between these two conditions, and to divide the cases into the two groups, is the difficult and important problem.

In order to determine whether there might be any diagnostic criteria that could be relied on to distinguish benign from malignant gastric lesions, Rivers and Dry made a careful comparative clinical study of the laboratory data in 100 cases of benign gastric ulcer and in 100 cases of malignant gastric ulcer. Evaluation of the information available in the histories of these cases corroborates the impression that some features suggest the probability that certain lesions are benign and that others are malignant.

Rivers and Dry concluded that a patient who has gastric ulcer should be suspected of harboring malignancy if the symptoms are of short duration, if they have persisted without remission, if relief from a careful medical regimen

is inadequate, and if blood has continued to appear in the stool. They expressed the belief that there is still greater probability that the lesion is malignant if, in addition, the ulcer is large, if it is situated near the pylorus on the greater curvature or anterior wall, and if hydrochloric acid is demonstrably absent from the gastric content or if the concentration of the acid therein is low.

Doctors Rivers and Dry also stated that certain criteria may suggest that the lesion is of a benign nature. This probability is supported if the patient is young, if there are long periods during which the ulcer is quiescent, if gastric acidity is high, if bleeding from the lesion is intermittent, and if the ulcer exhibits characteristics of penetration or if hour glass deformity is present. Added evidence is introduced to support the suggestion that the lesion is benign if clinical improvement takes place under treatment, if bleeding ceases, and if roentgenographic signs are obtained that the lesion is disappearing.

Altogether too frequently, however, the application of these same criteria has misled the physician in his judgment, to the serious jeopardy of his patient's life. In some cases in which the lesion is malignant, a medical and dietary regimen will be followed by prompt and practically complete relief of symptoms. Meanwhile, the lesion is permitted to progress stealthily; it is for this reason that only those patients who can be kept under close observation should be permitted to adopt such a plan of treatment, for it is based on the assumption that the lesion is benign. A sense of false security has developed among physicians with regard to the benign aspect of certain gastric lesions for which they have advised non-surgical treatment. This may usually be attributed to the fact that certain criteria have been utilized in some instances to the advantage of the patient and that in some of the cases the disease has been cured.

One must also bear in mind that gastric and duodenal ulcers coexist in 13 per cent of cases. The discovery of a duodenal ulcer may seem to explain the symptoms and for this reason a gastric ulcer may be overlooked if investigation of the stomach is not carried out carefully, either by fluoroscopic examination or by inspection at the time of surgical operation.

Even under direct inspection it is often impossible to distinguish between malignant and benign lesions of the stomach, although the size of the lesion does seem to be of some assistance in making the differential diagnosis. According to a study of the ulcers resected at the clinic, four out of five benign ulcers are less than 1.8 cm. in diameter, while 92 out of 100 are less than 2.4 cm. in diameter. Furthermore, in numerous instances, multiple ulcerating lesions are found in the stomach, one of which is malignant. Attention may be focused on the lesions that are benign and healing, whereas the ulcer that is smallest of all may harbor within its periphery unmistakable evidence of malignancy. Occasionally benign ulcers attain considerable size. It has been interesting to observe that 23 per cent of the carcinomas resected at the clinic were within the range of size of benign ulcers. All signs fail in so many instances that it would seem to be extremely hazardous to venture positive opinions regarding the exact histopathology, especially of small ulcers.

In carrying out the treatment, resection should be performed if the lesion is so large that excision of a considerable portion of the wall of the stomach would be required to remove the ulcer and therefore an extensive plastic procedure would be necessary to reconstruct the stomach. If the lesion is malignant grossly, it is usually preferable to perform resection. I think that one of the reasons for the willingness to operate on patients with gastric ulcer, before it is possible to demonstrate the presence of malignancy, is that such excellent

results have followed the conservative procedure of excision and gastro-enterostomy. About 80 per cent of all gastric ulcers are small, and excision will be all that is required. The immediate risk of the procedure is less than that of other operations for gastric ulcer. Subsequent formation of jejunal ulcer is not a consideration in operations on the stomach, for jejunal ulcer can be said to be almost exclusively a complication of procedures undertaken for relief from duodenal ulcer. I have been so impressed with the results of excision and gastro-enterostomy for gastric ulcer that I feel I should call attention to the operation at this time. Reports from many hundreds of patients indicate that this conservative operation apparently will accomplish a more satisfactory function result, and will give a better end-result than will come from resection of the stomach.

I also agree with Doctor Scott's statement that too pessimistic an attitude should not be adopted even if the criteria suggest the presence of a rather extensive malignant process. One is unable to state with certainty that a very small ulcer is benign, but it is also quite as impossible to be sure that a large ulcer, having considerable induration about it, will prove to be malignant.

On account of the difficulty of distinguishing between benign and malignant gastric ulcer and the danger of permitting malignant transformation to progress if medical treatment is given a trial, I think that practically all patients with gastric ulcer should be given the advantages offered by surgical removal of the lesion.

DR. FRANK H. LAHEY (Boston, Mass.).—This is a very important subject to take up from time to time. I think we all have to take the position, as Doctor Scott has suggested, that every gastric ulcer should be considered malignant until proven otherwise. On the other hand, it would be quite wrong if we resumed the attitude which we had in the past that all gastric ulcers are to be surgical because of the danger of malignancy. I do believe that the percentage of malignancy is relatively low and I believe that if we were to resect all ulcers on this basis the mortality of resection would more than parallel the mortality of malignant degeneration in ulcer.

We have proven to our satisfaction that there is no ulcer, when it is a tractable ulcer, which heals as satisfactorily under medical treatment as does gastric ulcer.

It is interesting to see these defects in the lesser curvature at the operating table. They are usually distortions. When you look at the ulcer with the abdomen open you do not find alcoves which correspond to the roentgenogram. They are, I think, retractions due to exudate in the gastrohepatic omentum and about the ulcer, and the rapid disappearance of this alcove defect in ten days to three weeks, is, I think, secondary to disappearance of this exudate.

Doctor Jordan in our Clinic has practiced, and I have preached throughout this country now for a number of years, this very attitude of which Doctor Scott speaks, and that is the test of malignancy by a trial of medical treatment. There is no such thing as an exploration of a chronic gastric ulcer. If you get that far and open the abdomen you resect it if you are in doubt, and if it is a frank cancer you are not in doubt.

The thing we have wanted always is preoperative help as to operative decision, because I would feel most depressed to do a subtotal gastrectomy on an untreated ulcer, have it prove to be a simple ulcer, and have the patient die. I would always feel that that patient might well have been handled under medical direction and so I have desired some preoperative indication which would justify the risk of subtotal gastrectomy.

We have preached and practiced these criteria, and I think they are de-



pendable—if, under two or three weeks of medical regimen, patients fulfill the following criteria, they may be safely continued under medical measures: (1) Complete disappearance of symptoms. (2) Complete disappearance of blood in the stools. (3) Most important, not only disappearance of the defect under the fluoroscope, but peristaltic waves must pass flexibly through the area where the ulcer existed.

If, in addition to that, there may be a return of the ulcer, surgery is immediately indicated; if there be hemorrhage, surgery is immediately indicated, and if one attacks the ulcer under these conditions, no matter what the outcome as to mortality, it is justifiable because the lesion is then either malignant or an intractable ulcer, and in either event, subtotal gastrectomy is justifiable.

I believe this plan (and it makes no difference whose it is, we are only interested in whether or not it is worth while) is a very valuable and comforting one to the surgeon. I do believe that patients under this trial of treatment should be in bed. If one has to make a decision for or against operation on the basis of this trial of medical treatment, then it cannot be too painstaking. It cannot be too accurate and if it is to be done, it should be explained to the patient so that he or she understands the need of complete rest in bed and an accurate regimen upon which to make the decision.

This plan has been of great help to me and has saved me numerous heartaches which I had before we employed it. I think this is an extremely valuable contribution in that it again impresses the need of a trial of preoperative medical management on all surgeons' minds.

DR. ROSCOE R. GRAHAM (Toronto, Ont.).—We too have followed the type of management preoperatively which Doctor Scott has outlined, and which has been suggested by Doctor Jordan of the Lahey Clinic.

We can most heartily endorse the soundness of this regimen. We have noted, however, that complete disappearance of all radiologic evidence of ulcer can occur, even showing peristaltic waves passing across the ulcer area during the fluoroscopic examination, and yet subsequent examination has proven such an ulcer to show malignancy. We place a certain reliance on the site of the ulcer. In an analysis of cases in which we took the incisura as the midpoint, we found that 94 per cent of the ulcers situated between the incisura and the pyloric vein were histologically malignant, while of those occurring from the esophagus to the incisura, only 40 per cent were malignant, and of the 60 per cent which were benign, 35 per cent had an associated hour glass contraction of the stomach. We also have had no patient past 60 years of age who had suffered from a simple gastric ulcer and in whom the symptoms of indigestion occurred after that age. Therefore in this group of patients we believe operation is indicated, but prior to operation all are submitted to bed rest with an indwelling duodenal tube. Even with such a regimen, if the ulcer should show a very material decrease in size, and be situated between the angularis and the pyloric vein, we still advise operation. We are very much impressed with the value of bed rest and an indwelling duodenal tube, even in malignant ulcers, as there is, as a result of this therapy, a marked diminution in the per ulcer inflammation and edema, thus lessening the likelihood of postoperative infection of the suture line.

The presence or absence of free hydrochloric acid is not of great significance in differentiating between benign and malignant ulcer, except that we very rarely see a malignant ulcer with a very high free hydrochloric acid content in the gastric analysis. The absence of free hydrochloric acid in gastric analysis is fairly common. We have recently carried out a series of gastric

analyses of patients admitted routinely for any cause, and found an absence of free hydrochloric acid in 50 per cent of the patients over 50 years of age.

DR. W. J. MERLE SCOTT (Rochester, N. Y.).—The seriousness of this problem is that carcinoma of the stomach is the most common cause of death from carcinoma. Twenty-five per cent of those carcinomas of the stomach appear clinically first as ulcer or mimic ulcer. The percentage of cases that exactly mimic ulcer, that you think after careful study of all clinical manifestations are probably benign ulcers, will perhaps not be that high.

But we should get across to practicing physicians and surgeons the fact that patients with lesions of the stomach that seem to be ulcers have a high incidence of carcinoma, and develop over a period of time a method of satisfactorily picking out certain lesions that should be operated on at once as carcinoma because of its high incidence such as that class which Doctor Graham called attention to in the prepyloric region—Dr. Holmes several years ago showed that the prepyloric ulcer was over 90 per cent malignant even though it was a very small ulcer.

If we call attention to these possibilities of handling the cases, separating out the majority of them that will respond to medical treatment within a short period of time, and yet submitting the others to whatever type of operation is carried out for carcinoma, I think we will have made a step forward in increasing the percentage incidence of cure of carcinoma of the stomach.

I certainly have no quarrel with Doctor Judd and I am sure he agrees with me. The only thing I wish to emphasize is that we should treat these cases, where they fail to respond to medical treatment, just as if one had the section of the lesion under the microscope. This proves to be carcinoma in a great many cases where one selects the case in that way. There will be a few of these ulcers that are adherent to the liver and pancreas, or have other complications that account for their failure to respond.

## ACUTE ILEUS

### COMPARISON OF TOXICITY OF OBSTRUCTED AND NON-OBSTRUCTED INTESTINAL CONTENTS

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#### PART I: QUALITATIVE

ACCEPTING the dictum that a poison was present in the obstructed intestine which could not be found in the unobstructed intestine, the experiments, the results of which are here reported, were begun in 1926. Their object was to ascertain whether or not, if such a poison did exist, there was any demonstrable time factor in its formation: in other words, whether the obstructed gut contents became more toxic the longer the obstruction lasted and, if so, how soon after obstruction they first began to be demonstrably toxic as tested by intravenous injection into other animals. If the results were positive, it was hoped that any definite time factor discovered might be used as a basis for rational recommendation regarding the possible use of enterostomy in human cases of acute ileus. A preliminary report<sup>1</sup> was published in 1927.

The published results of various investigators<sup>2, 3, 4, 5, 6, 7, 8, 9</sup>, up to that time were therein summarized as follows: "In obstructed intestines, the time factor for the formation of poison sufficient to cause marked sickness or death of the animal into which the content was injected (intravenously or intraaperitoneally) has been found by different workers to vary from four hours to ten days." These variations noted appeared to depend partly upon (a) the level of obstruction; (b) the type of obstruction, whether simple or by closed loop; (c) whether there was or was not any serious trauma to the intestinal or mesenteric blood supply; (d) the preparation of the content for injection; (e) the amount used for injection; (f) the variety of the animal used in the experiment; and (g) individual differences of reaction in animals of the same kind.

The experiments herewith reported were undertaken specifically to determine whether any more definite information than this could be obtained in relation to the length of time required for the formation of poison. In order to avoid some of the presumable causes of variation in results (noted above) the following limitations were imposed:

(a) The intestine was obstructed at the same level in all cases (about 30 cm. from the duodenojejunal junction). This point of obstruction was used in all cases except the 12 hour group in which a point a little higher was selected by mistake.

(b) The technic of obstruction was as nearly as possible the same in every case.

(c) Similar care was used in every case to avoid injury to the mesenteric vessels.

(d) The animals were killed by anesthetic in the same way at the end of the fixed period for each hour group, and were autopsied immediately. The mucosa and intestinal contents were removed in the same way in every case (immediately upon death of animal) into a fixed amount (200 cc.) of boiling water and sterilized by boiling for approximately five minutes. The material thus secured was extracted and prepared for injection by the same technic in every case.

(e) The amount injected was in each case the residue extracted from the entire content and mucosa of the obstructed segment of one dog up to the pylorus. This extract concentrated in water varied from 10 to 18 cc. in bulk.

(f) The same variety of animal (dog) was used in every case.

There remained at least four variables that were not controlled by these standards:

- (1) The actual amount of poison injected was unknown.
- (2) The animals used for injection test were not all of equal weight.
- (3) The animals injected differed somewhat in apparent physical condition.
- (4) No constant could be assumed as to their individual reactivity to the poison.

These variables are exceedingly important, for Ingvaldsen, A. O. Whipple, Bauman and Smith<sup>10</sup> showed that the dried extract of the ileus toxin was lethal to dogs injected intravenously in the amount of about 13 mg. to the kilo of body weight. The first two of the above variables could have been controlled but the last two could not. However, these variables (in addition to others) necessarily exist among cases of acute ileus in humans with which it was expected to compare the results of this experimental animal study. For this reason, in addition to the difficulty of procuring animals of exactly the same weight and because the technical process of securing the toxin in a dry refined state is long and difficult, these two controllable variables were left uncontrolled.

*Method: Typical Experiment.*—Through a median abdominal incision and with careful aseptic technic a presumably healthy dog under ether anesthesia had the jejunum tied off tightly by one-half inch cotton tape 30 cm. below level of duodenojejunal junction, except in the 12 hour obstruction group where (by mistake) the gut was ligated 30 cm. below pylorus, leaving a much shorter obstructed segment, care being taken not to injure the mesenteric vessels. The abdominal wound was closed, dressing applied and the animal returned to his cage. Water ad lib (but no food) was given after operation till death. The obstructed dog was killed by chloroform anesthesia

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at the end of a predetermined interval after obstruction.\* The abdomen was immediately opened and the intestine from pylorus to obstructed point 30 cm. below duodenojejunal junction removed. The content of this portion was squeezed into a beaker containing about 200 cc. of boiling water. The resected intestine was then split longitudinally, the mucosa was scraped off from the muscularis by the handle or back of a scalpel and transferred to the boiling water with the intestinal contents. Boiling was continued about five minutes and the contents of the beaker then transferred to a mason jar and removed to the Chemical Laboratory. The chemical treatment was that followed by Ingvaldsen, Whipple, Bauman and Smith.<sup>10</sup> The mixture was filtered through gauze and cotton and treated with five volumes of 95 per cent alcohol. The precipitate, dissolved in water, was boiled with 1 Gm. of magnesium sulfate, then filtered through paper and re-precipitated with five volumes of alcohol. The precipitate was dissolved in a small amount of water and dialyzed in a collodion sac against distilled water for five days with thymol used as a preservative. The neutral mixture, now free from magnesium sulphate, was centrifuged and the supernatant fluid removed, boiled with acetic acid for a few minutes, cooled and again centrifuged. The clear fluid again precipitated with alcohol was filtered and the precipitate dissolved in a small amount of water. The extract of the obstructed intestinal content and mucosa thus obtained† was sterilized by boiling and each specimen was tested as follows:

Under ether anesthesia in a presumably healthy dog, a small incision was made in left side of neck exposing left external jugular vein. Anterior wall of vein was picked up between fine toothed forceps and hypodermic needle introduced. The filtered, refined, sterilized intestinal extract (varying in bulk from 11 to 18 cc.) was slowly injected. The needle puncture was then closed by ligature, the wound in neck closed by suture and animal returned to cage for observation. They were observed at about hourly intervals for the first five or six hours following injection and after that not observed again till about 24 hours after injection. All dogs that died showed symptoms of severe toxemia, apparent discomfort, marked prostration, vomiting and purging which was frequently of blood tinged material, slow respirations, weak hind extremities. Every injected dog that died was autopsied as soon after death as practicable. There was found at autopsy in all cases the typical congestion of intestinal mucosa often accompanied with mucosal hemorrhages, and bloody intestinal con-

\* There were 5 hour-groups, of five or six dogs in each, as follows: Five 72 hour obstruction; five 48 hour obstruction; six 36 hour obstruction; six 24 hour obstruction (2 groups); six 12 hour obstruction.

† The amount varied between 11 cc. and 18 cc. in different instances. The color varied from watery opalescent to greenish or brownish and in some cases there was a small sediment at the bottom of the test tube. Experience showed that the color and sediment did not appear to indicate in any way the relative toxicity of the fluid.



tents which is apparently a characteristic effect of obstructed intestinal content poisoning.

The results of the tests may be tabulated as follows:

## GROUP A

*Adult Dogs — 72-Hour Obstruction*

Serial No. obstructed dog	Serial No. injected dog	Amount of fluid injected	Results
8240	8315	10 cc.	Slight toxemia. Recovery complete in 24 hrs.
8352	8413	15 cc.	Severe toxemia. Recovery after 24 hrs.
8269	8414	15 cc.	Very severe toxemia. Dead in 2¾ hrs.
8326	8415	18 cc.	Severe toxemia. Recovery after 24 hrs.
8358	8416	17 cc.	Severe toxemia. Dead in 6 to 24 hrs.

## GROUP B

*Adult Dogs — 48-Hour Obstruction*

8386	8547	10 cc.	Severe toxemia. Recovery after 48 hrs.
8359	8548	17 cc.	Severe toxemia. Recovery after 48 hrs.
8487	8549	14 cc.	Severe toxemia. Recovery after 48 hrs.
8447	8550	16 cc.	Severe toxemia. Dead in 5 hrs.
8430	8551	16 cc.	Severe toxemia. Dead in 6 to 19 hrs.

## GROUP C

*Adult Dogs — 36-Hour Obstruction*

8704	8773	14 cc.	Severe toxemia. Recovery after 24 hrs.
8714	8774	13 cc.	Severe toxemia. Dead in 10 to 23 hrs.
8717	8775	15 cc.	Moderate toxemia. Recovery after 24 hrs.
8723	8776	15 cc.	Moderate toxemia. Recovery in 24 hrs.
8730	8777	14 cc.	Slight toxemia. Recovery in 24 hrs.
8735	8778	16 cc.	Severe toxemia. Dead in 4½ hrs.

## GROUP D

*Young Puppies — 24-Hour Obstruction*

8826	8858	7 cc.	Moderate toxemia. Recovery within 24 hrs.
8827	8859	6 cc.	Severe toxemia. Dead within 2½ hrs.
8828	8860	6 cc.	Severe toxemia. Dead within 3½ hrs.
8829	8861	8 cc.	Severe toxemia. Dead within 3¼ hrs.
8830	8862	6 cc.	Severe toxemia. Dead within 3 hrs.
8831	8863	7 cc.	Severe toxemia. Dead within 3½ hrs.

Following our original hypothesis, it had been expected that the 24 hour obstruction contents would show less toxic power than that of the 36 hour, 48 hour and 72 hour groups. For that reason puppies, instead

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of adult dogs, were chosen as they were believed to be more susceptible, just as children are apparently more susceptible to intestinal disturbances than are adults: the injection of the intestinal content into a vein being held to represent a situation similar to its rapid absorption from the intestinal mucosa via its lymphatics and veins. The 24 hour obstruction poison when tested in puppies was, however, apparently so much more deadly than the longer obstruction poison that we were led to question the validity of the results as a fair comparison with the other hour groups. The test was, therefore, repeated, every factor being similar except that adult dogs were used for the injection as in the other hour groups. The results are tabulated below.

## GROUP E

### *Adult Dogs — 24-Hour Obstruction*

Serial No. obstructed dog	Serial No. injected dog	Amount of fluid injected	Results
9355	9397	10 cc.	Very slight toxemia. Rapid recovery.
9356	9398	12 cc.	Very slight toxemia. Rapid recovery.
9357	9399	12 cc.	Moderate toxemia. Found dead after 24 hrs. Pneumonia.
9358	9400	10 cc.	Very slight toxemia. Rapid recovery.
9359	9401	11 cc.	Slight toxemia. Rapid recovery.
9360	9402	10 cc.	Very slight toxemia. Rapid recovery.

The results in this second group of 24 hour obstruction were so different from the results in the first 24 hour group that we decided to try a 12 hour obstruction group. The results of this experiment are tabulated below.

## GROUP F

### *Adult Dogs — 12-Hour Obstruction*

Serial No. obstructed dog	Serial No. injected dog	Amount of fluid injected	Results
9095	9154	12 cc.	Very slight toxemia. Rapid recovery.
9096	9155	10 cc.	Severe toxemia. Dead in 5 to 8 hrs.
9097	9156	12 cc.	Very slight toxemia. Rapid recovery.
9098	9157	11 cc.	Very slight toxemia. Rapid recovery.
9099	9158	11 cc.	Very slight toxemia. Rapid recovery.
9100	9159	10 cc.	Very slight toxemia. Rapid recovery.

The fact that there were deaths in the early obstruction as well as in the late obstruction groups led us to question whether we had been justified in our original assumption that there was a poison in the obstructed intestine which could not be demonstrated in the non-obstructed intestine. We therefore decided to test by injection the toxicity of material from non-obstructed intestines obtained, refined, and injected in exactly the same way as the content of obstructed intestines had been. The results are tabulated below.

## GROUP G

*Adult Dogs — Non-Obstructed Control*

Serial No. non-obstructed dog	Serial No. injected dog	Amount of fluid injected	Results
9657	9775	about 10 cc.	Severe toxemia. Dead in 4 hrs.
9653	9776	13 cc.	Apparently recovering from toxemia after 4 hrs. but found dead 24 hrs. later.
9656	9777	11 cc.	Severe toxemia. Dead in 3 hrs.
9652	9778	11 cc.	No toxemia, apparently.
9655	9779	12 cc.	Very slight toxemia. Rapid recovery.

The death of three out of five dogs in this GROUP G (following injection of the extract of non-obstructed intestine) made it appear that there was actually present in the non-obstructed intestine a poison similar to that found in the obstructed intestine. Moreover, at autopsy, two out of the three dead dogs had the bright red congestion of the small intestine mucosa (most marked in the duodenum and fading toward the ileum) together with blood-tinged contents that we have previously associated only with the fatal toxemia following injection of obstructed intestinal contents. Findings in the third dead dog were suggestive but not convincing of the same pathology. It, therefore, seemed impossible to retain our original assumption that there was no similar poison in the non-obstructed intestine. This conclusion appears more inevitable if we summarize the results which have been tabulated above for the individual groups and contrast them with each other. A summary of the results (tabulated in individual groups above) is shown below.

*Summary of Results of Toxicity Tests of Various Obstructed and Non-Obstructed Contents*

Group	No. of dogs	No. died	Mortality per cent of group	Remarks
72-hr. obstruction	5	2	40	All adult dogs.
48-hr. obstruction	5	2	40	All adult dogs.
36-hr. obstruction	6	2	33 $\frac{1}{3}$	All adult dogs.
24-hr. obstruction	6	5	83 $\frac{1}{3}$	All young puppies. May have extra susceptibility.
24-hr. obstruction	6	1	16 $\frac{2}{3}$	All adult dogs.
12-hr. obstruction	6	1	16 $\frac{2}{3}$	All adult dogs.
Non-obstructed	5	3	60	All adult dogs.

This summary shows two striking features: the high mortality of the group of puppies injected with 24 hour obstruction fluid and the high mortality of dogs injected with non-obstructed intestine contents. Ignoring these two groups for the moment the above summary seems to indicate an increase in the toxicity of the obstructed contents with the longer periods of obstruction. But the two striking groups cannot be ignored. They must either be satisfactorily explained or it must be admitted that the original

assumption (poison present in obstructed contents but not in normal contents) is invalid and that the object of the experiments (to ascertain at what period—after onset of obstruction—poison becomes demonstrably present in the intestine) was unattainable.

If we had not used the puppies among the test animals and if we had not tested the toxicity of the non-obstructed contents, our results would have been apparently satisfactory, logically to be expected and rather convincing. But they would have been fallacious.

SUMMARY OF PART I

The results of this first group of experiments (designed to discover whether or not the contents of the obstructed intestine became demonstrably more toxic with the increase in the obstruction time) were inconclusive: first, because the test of the 24 hour material, on puppies, made it appear more toxic than the 36 hour, the 48 hour or the 72 hour material; and secondly, because the non-obstructed material appeared to be more toxic than the obstructed material.

It might be plausibly argued that the puppies tested were more susceptible than adult dogs and that, because of their small size, they received relatively larger dosage of the material than did the adult dogs. This argument could be supported by the fact that, when adult dogs were tested with similar (24 hour) material, they appeared to be—on a mortality percentage basis—five times more resistant than the puppies.

As regards the non-obstructed control tests, it might be argued that some of the apparently normal dogs, from which the non-obstructed intestines were taken, really had distemper with no other sign of it than the slightly congested mucosa which was noticed in two or three of them. The non-obstructed intestinal contents of dogs suffering from distemper have been shown by Ellis<sup>20</sup> to be decidedly toxic. All we can say, in this regard, is that—if they had distemper—the signs were too obscure for us to recognize and we considered these dogs to be healthy.

If now we should ignore the result of the test on the group of puppies (which would seem almost justifiable) and in the non-obstructed control group (which would not seem justifiable) it would appear that the first group of experiments indicated an increasing toxicity with the increase in length of obstruction time (based on an increasing percentage of mortality in the injection tests).

We do not, however, believe that this appearance is reliable. It seems rather to be fallacious, particularly when viewed in the light of the results of the second group of experiments (whose report follows) which were designed to compare quantitatively the relative toxicity of obstructed and non-obstructed contents. But even in the light of these qualitative tests, we believe the non-obstructed contents to be toxic.

## PART II: QUANTITATIVE

On the assumption that there was poison present in non-obstructed intestine, the question arose as to whether it existed in amounts at all similar to those found in the obstructed intestine.

Ingvaldsen, A. O. Whipple, Bauman, and Smith,<sup>10</sup> in 1923, secured 1 Gm. of dry toxic substance from the obstructed intestine of 14 dogs, using a method of chemical extraction similar to that described by Ellis but with additional steps to further purification. Seventy-one mg. of this toxic substance dissolved in water and injected intravenously into a dog weighing 5½ kilos (13 mg. to the kilo) resulted in a characteristic toxemia and in his death in 2¾ hours. Autopsy showed the characteristic intestinal pathology of intense mucosal irritation.

In 1928, we killed by chloroform five presumably healthy dogs and removed into boiling water the contents and mucosa of nearly the entire small intestines. Through the kindness of Dr. Edgar G. Miller, this was treated in the Department of Biochemistry by exactly the same method of extraction and purification which Ingvaldsen and collaborators had reported in the case of obstructed contents. The dry substance thus secured weighed 186 mg. It was of dirty white color, chalky consistency and when dissolved in water made a cloudy, opalescent solution. Two apparently healthy dogs were selected and the toxin, dissolved in water and freshly sterilized by boiling, was slowly injected into the external jugular vein exactly as in the previous experiments. The results are tabulated below.

## GROUP H

*Adult Dogs — Non-Obstructed Controls*

Serial No. injected dog	Weight of dog	Weight of dried extract cc. water	No. of mg. per kilo	Results
9972	5.9 Kg.	75 mg. in 7.5 cc. water	12.7	Vomiting and purging and marked depression. Moribund in 8 hrs. Found dead next day. Pneumonia.
9973	6.1 Kg.	90 mg. in 9 cc. water	14.7	No vomiting or purging. Moderate depression. Almost completely recovered at end of 8 hrs.

There are two interesting points of contrast here indicated between the contents and mucosa of obstructed and non-obstructed intestine: (1) The amount of dried extract obtainable (using the same chemical method); and (2) its effect when injected intravenously.

From the obstructed intestine of 14 dogs was obtained 1,000 mg. of dried extract, an average of 71 mg. per animal. From the non-obstructed intestine of five dogs was obtained 186 mg. of dried extract, an average of 37 mg. per animal. When injected intravenously (in approximately the same amount of mg. per kilo of body weight) the obstructed extract killed a dog in 2¾ hours with autopsy findings typical of acute ileus poisoning. The non-



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obstructed extract had very slight apparently toxic effect on one dog and, when tested on another, showed only moderate effect within four hours and, although this latter dog was found dead the next day there were no characteristic pathologic findings as in acute ileus poisoning and there was an early pneumonia of one lung which probably contributed to its death. These observations were so much at variance with those in GROUP G, where the less refined non-obstructed contents accounted for a 60 per cent mortality of injected dogs, that it seemed worthwhile to persist in the attempt to compare quantitatively the toxic effect of obstructed and non-obstructed contents.

In 1935, therefore, a group of 13 non-obstructed, apparently relatively normal dogs were killed by chloroform, the small intestinal contents and mucosa from pylorus to cecum were removed and treated by the same method used in 1924 by Ingvaldsen, A. O. Whipple, Bauman and Smith.<sup>10</sup> The chemical work was done in the chemical laboratory of the Department of Surgery at the College of Physicians and Surgeons by Miss Hamlin under the direction of Dr. Louis Bauman. Nine hundred and twenty mg. of dry residue was secured by this method from 13 non-obstructed dogs as compared with 1,000 mg. obtained from 14 obstructed dogs in 1924. This dried residue was dissolved in 92 cc. of 0.9 per cent sterile Na Cl solution (10 mg. to 1 cc. of solution) and, being found slightly acid, was neutralized to phenolphthalein by adding a little sodium carbonate. The resulting solution was without precipitate, almost water-clear and colorless. The toxicity of the material was tested by injection into the external jugular vein of presumably healthy adult dogs, exactly as in the earlier experiments. The following table shows the amount injected and the results observed.

## GROUP J

### *Adult Dogs — Non-Obstructed Controls*

Serial No. injected dog	Weight of dog	Weight of dry extract	No. of mg. per kilo	Results observed
12825	14.7 Kg.	147 mg.	10.0	No sign of toxemia except slight depression.
12829	4.9 Kg.	70 mg.	14.3	Severe toxemia. Vomiting and purging. Recovered in about 6 hrs.
12826	14.0 Kg.	210 mg.	15.0	Moderate toxemia. Purging and depression. Recovery after 6 hrs.
12827	13.1 Kg.	209 mg.	16.0	Vomiting, purging, coma. Death in 2½ hrs. Characteristic autopsy findings.
12828	12.7 Kg.	216 mg.	17.0	Severe toxemia. Vomiting. Bloody stools. Recovery after 24 hrs.

Reviewing the results, it seems impossible to deny that this material, obtained from the non-obstructed intestines of apparently healthy dogs, is toxic. Bearing in mind the fact that it was obtained by exactly the same method of

chemical extraction which had been used by Invaldsen, Whipple, Bauman and Smith, in the obstructed intestine; added to the fact that, when injected into dogs, in the same way and in about the same amount as the obstruction poison, it gave rise to similar symptoms, one is inclined to believe that its toxicity may be due to similar (if not the same) factors as in obstruction poison. It is possible, of course, that the poison may be the same as obstruction poison, but we have no evidence to justify such an assumption, because we made no chemical analysis of the non-obstructed extract.

One does not know whether the poison extract resides originally in the intestinal contents or in the mucosa. In the case of these non-obstructed dogs, it would appear to be in the mucosa. For the total contents recovered from the non-obstructed intestines of 13 dogs was only about 20 cc. of fluid and the usual worms. There was, however, roughly about three times as much mucosa taken by us from the non-obstructed intestines as was taken by Ingvaldsen, Whipple, Bauman and Smith from the obstructed intestines for chemical extraction. The entire small intestine was used in the former case, and only the obstructed segment in the latter. The contents of the obstructed intestines was, however, far greater than that of the non-obstructed intestine.

In both instances (obstructed and non-obstructed) approximately the same amount of extract was secured, in a dried to constant weight form. An average of 71.4 mg. was recovered from each of the obstructed dogs and an average of 70.8 mg. from each of the non-obstructed. Taking into consideration the fact that there was more contents and less mucosa in the obstructed dogs, it seems possible that the poisonous extract may have resided largely in the contents. In the case of the non-obstructed dogs, however, there was so great a preponderance of mucosa over contents that it seems probable the mucosa was largely the source of the extract.

Collecting the results, both qualitative and quantitative, of the toxicity tests and dividing them into two groups, Obstruction Extract and Non-Obstruction Extract, we may tabulate them as follows:

<i>Comparative Toxicity</i>	
<i>of</i>	
<i>Obstruction Extract</i>	<i>Non-Obstruction Extract</i>
No. of specs. tested..... 34	No. of specs. tested..... 12
No. producing symptoms..... 34	No. producing symptoms..... 11
No. resulting in death..... 13	No. resulting in death..... 5
Confirmed by autopsy..... 13	Confirmed by autopsy..... 4
Mortality rate 38.2%	Mortality rate 41.7%

## SUMMARY OF PART II

The second group of experiments (designed to test the toxicity of non-obstructed intestinal contents and mucosa and to compare the amount of poison and its degree of toxicity with that found in the obstructed intestine) were more convincing in their results. From them it appeared:

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(1) That there is a toxic substance in the non-obstructed intestine whose action, when tested by injection, is similar to that of the so called obstruction poison.

(2) That, when quantitatively tested, it appears to be about as toxic as the obstruction poison.

(3) That (judging by the amount of mucosa used for the extraction and the amount of extract secured, in the obstructed and non-obstructed groups) the poison exists in smaller amounts in the non-obstructed than in the obstructed intestine. If these appearances are accepted as valid representation of the facts (and we are inclined to accept them as such) they argue against the commonly held conception of obstruction toxemia: that is as being due to a peculiar obstruction poison formed only after the onset of obstruction. They tend to suggest rather the prior existence of a poison in the non-obstructed intestine which, after the onset of obstruction, is collected there in larger amounts, due to the lowered absorption from an obstructed intestine and to the impossibility of discharging it through the normal channel. They tend similarly to strengthen the claims of those who argue that the normal uninjured mucosa does not allow to pass into the lymphatics and blood vessels poisons which are apparently able to pass through the mucosa after it has been injured sufficiently to interfere with its integrity as a protective agent.

### DISCUSSION

From these collected observations, therefore, one gets the impression that there is little difference, qualitatively and quantitatively, between the toxicity (intravenously injected) of the extract from obstructed and non-obstructed intestinal contents in dogs. The observations reported herein are, however, too few to carry much weight by themselves and confirmatory evidence must be sought to reinforce the impression that they give. Such confirmation may be found in the reports of work done by Kukula,<sup>6</sup> Charrin,<sup>12</sup> Bouchard,<sup>11</sup> Magnus-Alsleben,<sup>13</sup> Roger and Garnier,<sup>14</sup> Falloise,<sup>15</sup> Cybulski and Tarchanoff,<sup>16</sup> Braun and Boruttau,<sup>17</sup> Davis, D. M.,<sup>18</sup> Wangenstein and Chunn.<sup>19</sup>

Bouchard, in 1887, tested the watery (also alcohol and ether) extracts of non-obstructed intestines by injection into animals and reported them to be toxic.

Kukula, in 1901, investigating normal intestinal contents, found toxic substances and classed them as (a) breakdown products of carbohydrates and (b) putrefaction products of proteins.

Charrin, in 1904, stated that, in its non-obstructed condition the intestinal contents are poisonous.

Magnus-Alsleben, in 1904-1905, said that a toxic substance existed in non-obstructed, upper small intestine contents and mucosa after feeding various kinds of meat and apparently also after bread, fats and starches.

Roger and Garnier, in 1905-1908, tested by injection the toxicity of gastric, small intestine and colon contents of non-obstructed intestine. They

used dogs and rabbits and reported that the contents of the small intestine were more toxic than gastric or colon contents. Their conclusion regarding the non-obstructed contents was that it was remarkable for the constancy of its toxicity and for the consistency of its toxic dosage. Then, comparing the toxic dosage of obstructed small intestine content with that of the non-obstructed, they reported that the latter was rather more poisonous than the former. They precipitated the obstructed contents with alcohol and found the precipitate (dissolved and injected in water) very fatal while the filtrate was only mildly toxic. Their final conclusion regarding the relative toxicity of obstructed and non-obstructed contents was that occlusion of the intestine (obstruction) in dogs lessens the toxicity of its contents below that of normal contents.

Fallose, in 1907, made a careful study of the various products of digestion found in the intestine of the human and of certain animals. He stated that the normal contents of human intestine was toxic for dogs and rabbits (as tested by injection into vein) and that normal contents of these animals were also toxic for the same animals. He studied only the non-obstructed contents believing that the obstructed contents were abnormally conditioned. He sterilized the watery extract of intestinal contents by tyndallization (repeated to 55° C.) and his experimental work was carefully planned and executed. His deductions were thoughtfully made and are highly convincing. He recorded accurately the symptoms produced by the injections. The most striking and consistent symptoms were (1) rapid fall of blood pressure, (2) severe dyspnea, (3) incoagulability of the blood, and (4) hypoleukocytosis. He said that the severity of the symptoms and their rapidity of onset appeared to depend upon (a) the amount injected, (b) the speed of injection, and (c) the individual resistance of the dog tested. His final conclusion was that normal, non-obstructed contents were toxic and that the toxicity probably came from products of digestion in the small intestine as the contents of this were more poisonous than those of large intestines.

Cybulski and Tarchanoff, in 1907, repeated enough of Fallose's experiments to confirm his results. But they differed from his deduction that the toxicity of normal intestinal contents was due to digestive products. They claimed that the toxicity was due to the digestive ferments and particularly to the pancreatic juice.

Their final conclusion was that normal intestine contents were toxic but that the toxicity was due largely to the presence of pancreatic juice; because, by injecting the latter alone, they secured results almost entirely similar to those of Fallose's injections with small intestine contents.

Brown and Boruttau, in 1908, after numerous obstruction experiments on dogs and cats, undertook a similar research on apes. They called attention, in their report, to the fact that several previous investigations had claimed that obstructed contents were more toxic than normal contents. Brown and Borut-

tau, however, felt that the methods used had not been sufficiently exact to make such claims convincing.

They themselves had found that, in certain injection experiments, using equal amounts of obstructed and of non-obstructed contents, the latter was sometimes lethal and the former was not. They did not, apparently, as Roger and Garnier had, test quantitatively with any exactness the relative toxicity of obstructed and non-obstructed contents. However, they secured the strong impression that obstructed contents may be no more toxic than normal contents. They found that absorption from the intestine was slowed down by obstruction conditions. In general, they agreed with the work of Roger and Garnier and of Falloise. Finally, they concluded that there was no demonstrable proof of a special obstruction poison and that the normal intestinal contents were rather more toxic than the obstructed contents. Moreover, they held that absorption from an obstructed intestine was so greatly slowed down that in some cases the presence of a lethal dose of strychnine in the obstructed gut failed to cause strychnine poisoning.

Davis, in 1914 found the normal intestinal contents of dogs, containing the ordinary food residues, fatally toxic when injected intravenously into other dogs. He also made fistulae in dogs 35 cm. below the pylorus and tied off or dissected away the pancreatic and bile duct so that no bile or pancreatic juice could enter the gut. Fluid syphoned from these fistulae, when injected intravenously into other dogs, had, in all cases, effects identical with those caused by injection of closed loop fluid. He accepted this as evidence that normal small intestine secretion without the presence of bile or pancreatic juice was quite definitely toxic.

Wangensteen and Chunn, in 1928, compared the toxicity of obstructed and normal intestinal contents, using dogs. They used contents only, apparently, and no mucosa. The normal contents were expressed (after killing the animal) from the whole of the small intestine. The contents of obstructed dogs (after two or three days obstruction) were expressed separately from above and from below the point of obstruction and tested separately. The contents were filtered (under suction) until clear, often colorless and sterile. The amount injected was usually about 15 cc. The normal contents were injected into seven dogs with mortality of 28.6 per cent. The obstructed contents were injected into ten dogs with no mortality. They then tested on rats the normal and obstructed contents of dogs. The normal contents (injected intraperitoneally) gave a 7.7 per cent mortality; the obstructed contents (from above the obstruction) gave a 9.9 per cent mortality and the contents from below the obstruction gave a 75 per cent mortality. Normal contents of rabbits' intestine injected into rats (intra-peritoneally) gave 33.3 per cent mortality and obstructed contents gave a 20 per cent mortality.

Their conclusions were that all intestinal contents were toxic on injection; furthermore, that the contents of non-obstructed dog or rabbit when injected



gave rise to the same symptoms as obstructed contents and were just as toxic.

Taking these reports collectively, we have here a considerable weight of evidence in favor of a definite poison or poisons existing in the contents and mucosa of the normal, non-obstructed small intestine: a poison which when injected intravenously gives rise to symptoms similar to those caused by the injection of obstructed contents.

If this evidence be accepted as valid it would seem hardly profitable to look any longer for a specific obstruction poison; an acute ileus toxin. For, if similar poisons are present in the intestine before and after obstruction, the vital question is not how and why they are formed but rather how and why they are absorbed, in lethal dosage, after obstruction and not before.

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## CIRCULATORY DISTURBANCES CAUSED BY INTESTINAL OBSTRUCTION

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INTESTINAL obstruction may disturb the circulation of the bowel wall, the intra-abdominal circulation as a whole, and the systemic circulation. The causes, effects, and interrelations of these disturbances make up the subject matter of this paper. For the literature up to 1911 we have relied chiefly on the article by Enderlen and Hotz.<sup>1</sup> The Library of the Surgeon General has over 5,000 references on intestinal obstruction. The existence of this vast literature is sufficient proof that knowledge of the subject is imperfect. The bodily derangements caused by intestinal obstruction are too complex and widespread to permit of simple explanation. Since the circulatory phenomena of ileus are of constant occurrence and primary importance, it has seemed to use that the accumulation of exact information about them is a prerequisite to progress in the study of the disease.

We report our results and conclusions to date. In the course of this work we have encountered many problems which still demand solution. It is our impression that the conditions involved in many recorded experiments on bowel obstruction have been so complicated that clear cut conclusions cannot be drawn from their results. To avoid this error we have tried to use simple experiments which give definite answers to single questions, and to draw no general conclusions which these answers do not justify.

*Disturbances of the Circulation Through the Bowel Wall.*—The most important causes of impaired circulation in an obstructed bowel are distention and interference with the flow of blood in its mesentery. Increased peristalsis, disturbed vasomotor action, increased intra-abdominal pressure, and impairment of the systemic circulation are additional causes which should be considered. Kader<sup>2</sup> was the first to make a scientific study of the effects on the bowels of venous congestion and distention. He underestimated the effects of distention. This was because his experiments were done on the dog, whose intestine has a powerful muscular coat, which is able to empty accumulations of gas and fluid above an obstruction into the stomach, whence they are expelled by vomiting. The dog's intestine is thus protected against distention. The rabbit has a thin intestine and cannot vomit. Its intestine is readily injured by distention. The effect of distention upon the human intestine is probably about intermediate between these extremes.

Kocher<sup>3</sup> was probably the first to call attention to the injurious effects of distention alone upon the bowel. His observations were clinical. Van Buren<sup>4</sup> and Van Zwalenburg<sup>5</sup> have made valuable experimental studies of the subject, the results of which we have utilized.

In this study simple experiments devised to disclose the relation which

exists between intra-intestinal pressure and blood flow through the bowel wall, and which demonstrate the exact effect of various amounts of intra-intestinal pressure upon its viability, motility, secretory activity and power of absorption, have been used; also experiments which show the results of uncomplicated venous obstruction.

*Effects of Distention on the Circulation of the Bowel.*<sup>6</sup>—These can be studied conveniently in the experimental animal by the isolation between ligatures of a segment of intestine in which the intra-intestinal pressure can be varied at will. The ligatures are so placed that they include a stretch of intestine drained by a single vein. The set up of the experiment is shown in Fig. 1.

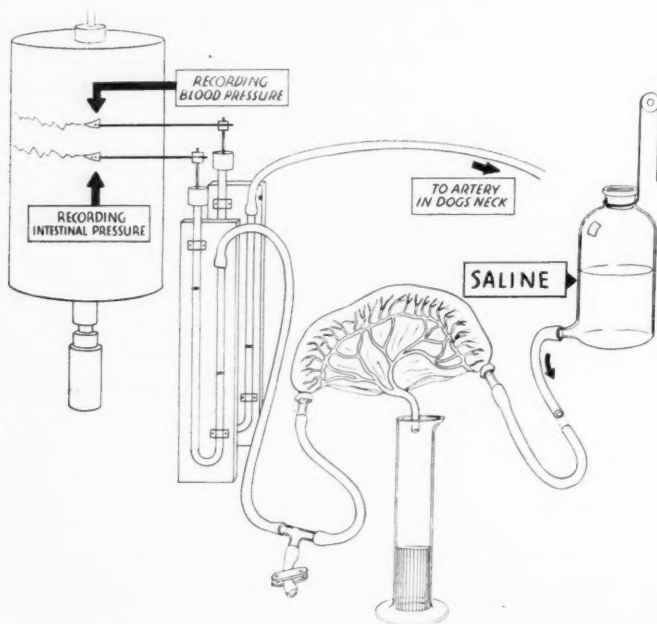


FIG. 1.—Set up of experiment to show effects of distention on circulation of bowel.

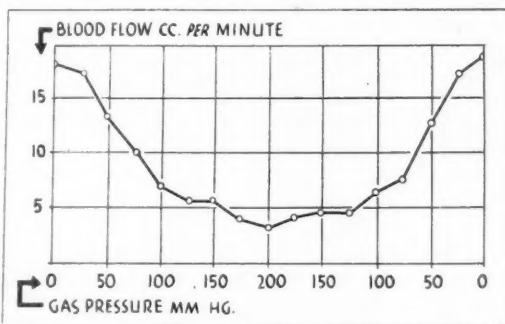
Distention causes a marked blanching of the bowel, which grows paler as the distention increases. We have measured the venous outflow from a segment of intestine, prepared as just described, and have found that it decreases as the intra-intestinal pressure increases, and that it ceases entirely when the intra-intestinal pressure equals the systolic blood pressure. C. A. Dragstedt<sup>7</sup> has confirmed and amplified this work. Fig. 2 represents a curve obtained by plotting the measured outflow of blood, during equal intervals of time, within each of which the intra-intestinal pressure was maintained at a measured height.

Microscopic study of sections of bowel, fixed with formaldehyde, while inflated to 20 Mm. of mercury pressure, shows that the tissues of the bowel wall have been stretched and compressed, that this deformity affects the

mucosa more than the muscularis, and that the blood vessels of the mucosa are nearly all empty, though the vessels under the peritoneum still contain blood (Fig. 3).

It is evident that the strong submucous coat of the bowel protects the layers of tissue external to it from the full effects of the intra-intestinal pressure. This explains why the anemia of the mucosa is more nearly complete than that of the muscularis.

We conclude from this study that an intra-intestinal pressure as low as 20 Mm. of mercury produces an almost complete anemia of the mucosa of the bowels. It occurred to us that it might be possible to estimate the force of the intra-intestinal pressure by measuring changes in the diameter of a segment of bowel caused by various pres-



CURVE SHOWING THE AVERAGE READING OF BLOOD FLOW IN CUBIC CENTIMETERS PER MINUTE THROUGH INTESTINAL WALL UNDER VARYING DEGREES OF GAS PRESSURE IN THE LUMEN.

FIG. 2.—Curve obtained by plotting the measured outflow of blood, during equal intervals of time, within each of which the intra-intestinal pressure was maintained at a measured height.

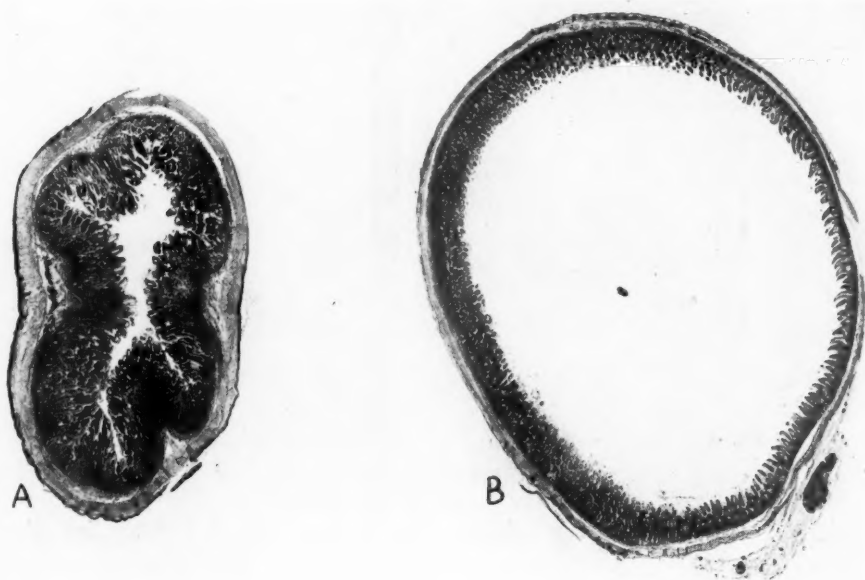


FIG. 3.—(A) Section of bowel inflated with a pressure of 20 Mm. of mercury. (B) Section of uninflated bowel for comparison.

ures. Data so obtained by means of roentgenograms might be of clinical value. To test the accuracy of the method we experimented with a piece of human intestine obtained at an early autopsy. We found that this would be

distended to a diameter of seven-eighths inch by a pressure of only 5 Mm. of mercury and that this diameter was not increased to a measurable extent by any higher pressure up to the pressure which ruptured the bowel. Rupture in one test, in which the pressure was maintained at 125 Mm. of mercury occurred after three hours. In another test in which the pressure was rapidly increased, rupture occurred at 210 Mm. of mercury.

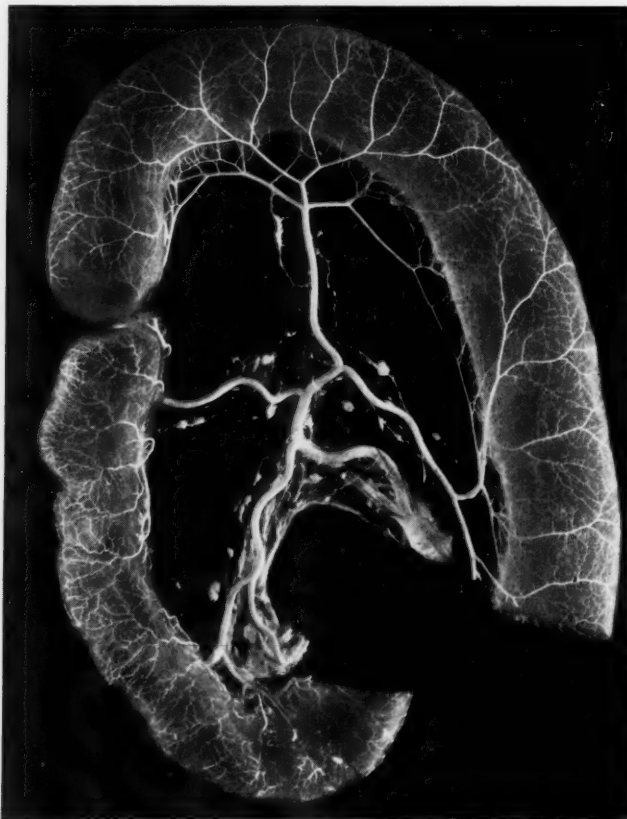


FIG. 4.—Photograph of a piece of bowel, the arteries of which have been injected with bismuth oxychloride; while one part of it was uninflated, the other part was inflated with a pressure of 30 Mm. of mercury. It will be noted that the arteries do not form simple girdles around the bowel, but that they pursue a convoluted course around it. This enables them to accommodate themselves to any increase in the circumference of the bowel without a decrease in lumen due to stretching. The arteries seen in the inflated part are all superficial. Note the complete absence of injected vessels in the end of the inflated part next to the ligature.

In an experiment performed on a dog, we discovered that the intestine, kept within the abdomen, will be slowly distended to several times its normal diameter by a pressure gradually elevated to 60 Mm. of mercury. Bowel so distended is often observed in the human. If the pressure in a bowel which has been stretched in this manner is reduced, the circulation through the bowel wall will be restored, though probably in an impaired condition (Fig. 4).

From these observations, and from our study of the histology of the dis-



tended bowel, we conclude that the demonstration in patients with acute intestinal obstruction of loops of small intestine having a diameter of two or three inches, even though they may be loops of jejunum, indicates that the circulation of the affected loops has been seriously impaired. The stretching to which the intestine has been subjected explains the slow return of peristalsis so often observed, clinically, after the relief of a prolonged obstruction. It also explains why the obstruction may not be relieved by enterostomy or by other means.

*Effect of Distention upon Secretion by the Bowel.*—We inflated long loops of empty bowel to various levels of pressure, which we maintained from three to four hours. We observed that the peritoneum of the inflated bowel is soon covered by drops of fluid, which is evidently plasma squeezed out of it. We could collect practically no fluid from the lumen of the bowel.

These observations prove that increased intra-intestinal pressure diminishes the secretion of the bowel, and that at constant pressures of over 10–15 Mm. of mercury very little fluid collects in an inflated intestine. When there is no blood in the tissues, they have no fluid to secrete.

Some writers have attributed venous congestion in the bowel to increased intra-intestinal pressure. Our observations do not support this idea, except as it applies to very low pressure. We have never observed congestion of the bowel in experiments in which distention was the only force acting upon the intestinal circulation. It is evident that distention compresses the capillary bed of the bowel wall so that there is a diminished blood flow in the veins. We attribute the congestion of the bowel so frequently observed above an intestinal obstruction, (1) to the pressure of distended loops upon the mesentery loops not so greatly distended; (2) to torsion and stretching of the mesentery whereby the mesenteric veins are partially obstructed; and (3) probably most important of all, to the effect of the partial venous occlusion produced by the two causes just mentioned, in the presence of the greatly increased arterial blood flow which accompanies the vigorous peristaltic action set up in the afferent bowel by rather low intra-intestinal pressure. We have observed some reactive hyperemia after deflation of the bowel. Note that the curve of the blood flow shown in Fig. 2 reaches a higher level at the close of the experiment after deflation than it reaches at the beginning before inflation.

*Effect of Distention upon Absorption.*—The effect of distention upon the ability of the intestine to absorb is shown by the following experiment:

Into a closed segment of bowel, kept outside the abdomen, and distended by a pressure equal to the systolic blood pressure, a solution of potassium cyanide is injected. No toxic effect upon the animal can be observed. The pressure within the bowel is then gradually reduced. No effect is observed until the intra-intestinal pressure has been lowered to about the level of the diastolic blood pressure. Then the animal immediately shows the effects of the poison.

This experiment proves that absorption from the bowel by way of the mesenteric vessels is prevented by intra-intestinal pressure greater than the diastolic blood pressure.

If the closed segment of bowel, kept inflated by a pressure greater than the diastolic blood pressure, and containing the solution of potassium cyanide, is placed within the abdomen, the animal will show the effects of the poison after an interval of a few minutes. This result, in combination with that of the preceding experiment, proves that transperitoneal absorption from a loop of bowel distended by a pressure greater than the diastolic blood pressure can occur. It is to be noted that transperitoneal absorption of materials not normally absorbed by the bowel will not occur before the mucosa has become devitalized.

We have tested the effect of intra-intestinal pressures between zero and the level of the diastolic blood pressure upon the rate of absorption of alcohol and of sodium bromide by the bowel. These substances were selected because they are readily absorbed, and because their volumetric estimation in the blood can be made with great accuracy. The set up for the experiment was the same as that used to measure the effect of intestinal pressure upon the rate of blood flow through the intestinal wall, except that the segment of bowel was distended by a solution containing 5 per cent of alcohol and 5 per cent of sodium bromide instead of by air.

We found that the rate of absorption remained relatively constant for all gradations of intra-intestinal pressure between zero and the level of the diastolic blood pressure. The rate of absorption depends upon how fast the epithelium of the mucosa can transmit the absorbed substance to the capillaries beneath it. These will carry it away as long as blood is passing through them. The concentration of the absorbed material in the venous blood varies inversely as the volume of blood flow. The absorption of gases from the obstructed bowel requires further investigation (Fig. 5).

Thus for all pressures between 10 Mm. or 15 Mm. of mercury and the level of the diastolic blood pressure the rate of absorption of any material, water and inert gases excepted, normally absorbed by the bowel, is relatively constant. For pressures above the diastolic pressure, transperitoneal absorption occurs, but no absorption by way of the mesenteric vessels.

Enderlen and Hotz<sup>1</sup> discovered that the rate of absorption of solutions containing salt or glucose by the obstructed bowel is much slower than the normal rate. They did not measure the intra-intestinal pressure.

We are at present making an experimental study of the effect of distention on the absorption of water by the intestine, but have not yet come to final conclusions about it. The rate of absorption seems to be governed by the osmotic pressure of the fluid within the bowel lumen, and by the volume of blood flowing through the intestinal wall. Since the mucosa can transfer electrolytes from the bowel lumen to the blood, it can lower the osmotic pressure of the bowel contents to a level at which water will pass from them into the blood. Fig. 6 shows that in the presence of bowel distention there is a great concentration of electrolytes in the venous blood of the bowel wall. This should

favor the absorption of water. The fact that its absorption is diminished must be due to the diminished blood flow caused by distention. When the distention is great enough to arrest the circulation of the bowel, the absorption of water, except by the transperitoneal route, must cease.

*Effect of Distention on Motility of Bowel.*—If a segment of bowel in the dog be distended with water, and the pressure within it measured by a mercury manometer, the bowel will usually show vigorous peristaltic movements when the manometer registers a pressure of from six to ten Mm. of mercury. These as a rule decrease as the pressure is increased, and cease entirely when the pressure is greater than 30 Mm. Because of the weak musculature of the human intestine, its peristalsis is probably stopped by a much lower pressure.

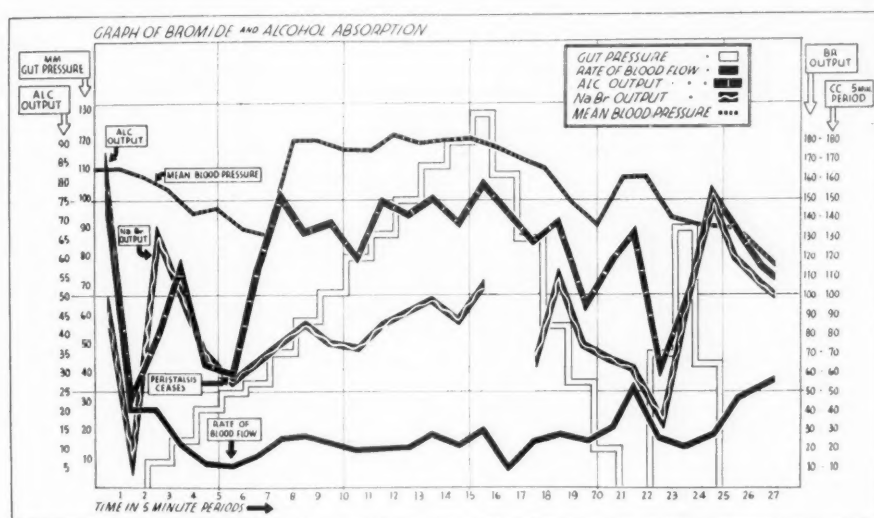


FIG. 5.—Curves showing blood pressure, volume of blood flow, total absorption of bromide and alcohol, and intra-intestinal pressure. The fluctuations in blood flow observed in the early part of the experiment were due to peristaltic action. Note that the curves of alcohol and bromide absorption preserve a fairly constant level without relation to the other curves.

Since it is well known that a totally anemic intestine can contract powerfully, it is evident that the failure of peristalsis, under the conditions of the experiment, is due to stretching of the muscularis, and not to anemia.

*Effect of Distention upon Viability of Bowel.*—When a loop of intestine is inflated with a pressure equal to the systolic blood pressure, and suddenly deflated, its function seems unimpaired as tested by its power to contract. Furthermore, if a process of alternate inflation and deflation is carried out a number of times, it seems to have no injurious effect on the bowel. We have maintained segments of bowel in an inflated condition under great tension for as long as three to four hours, and have found at the end of this time that they would contract vigorously when pinched; also, that microscopic sections of them showed no demonstrable injury. Carlson and Wangenstein<sup>10</sup> have made the same observation. While these experiments demonstrate that even extreme and prolonged distention injures the bowel surprisingly little,

they do not prove that distention as it occurs in cases of ileus in man does not injure the bowel. Clinically, the distention may be present for many hours longer than it was observed in these acute experiments. Furthermore, prolonged distention, produced experimentally, injures the bowel.<sup>4</sup>

It is a matter of great importance to determine how long a bowel can survive when subjected to an intra-intestinal pressure high enough to arrest its circulation. Fortunately, we have a well recognized method for obtaining this information. Cohnheim states that the power of selective absorption is a property of living intestinal mucosa, which dead mucosa does not possess. By determining how long the mucosa of a detached piece of bowel retains this power, we can determine how long it can survive when deprived of circu-

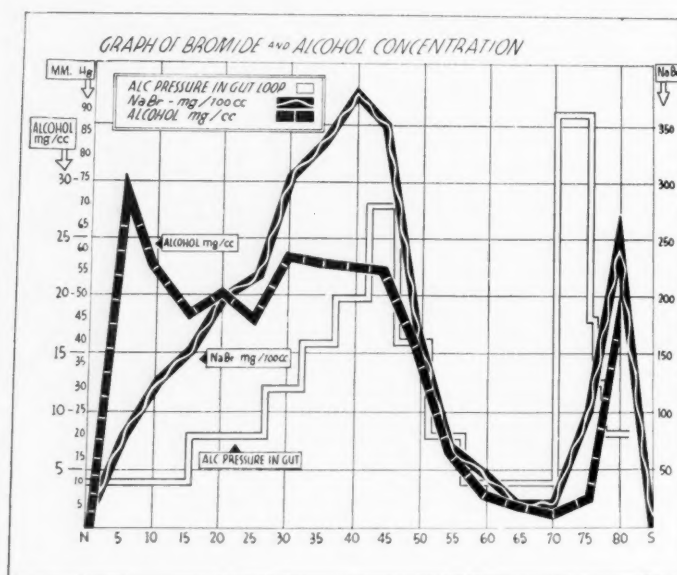


FIG. 6.—Curves showing intra-intestinal pressure and concentration of alcohol and bromide in the blood. It is to be remembered that the rate of blood flow varies inversely as the intra-intestinal pressure. If the rate of absorption remains constant, the concentration of the absorbed material in the blood must increase as the volume of blood flow decreases.

lating blood. The normal intestine will not absorb histamine, proteoses or peptones. We can regard the passage of these substances through the mucosa as proof that it is dead. Dr. J. H. Weatherby of the Department of Biochemistry of the Indiana University School of Medicine has made this determination by means of diffusion experiments on detached rabbit intestine. He reports that this holds back histamine for about five hours and proteoses and peptones for 15 hours, and determined that distention of the detached bowel, living or dead, does not affect appreciably the rate at which substances pass out of it. The circulation of the bowel is stopped by an intra-intestinal pres-

sure higher than the systolic blood pressure, and almost stopped by much lower pressures. It is in essentially the same condition as a detached bowel. We can therefore infer that its mucosa will be damaged after five hours, and entirely devitalized after 15 hours.

In clinical obstruction the afferent bowel is probably not subjected to pressure high enough to damage its circulation until the obstruction has existed for a long time. The bowel may be able for hours or days to empty its contents upward into the stomach and thus keep down the pressure. While the fact that it may be devitalized and rendered necrotic by high intra-intestinal pressure is certain, it is impossible in a given case to determine how long the dangerous pressure has been present continuously.

*Experiments Showing the Effect of Interference with the Mesenteric Circulation—Strangulation.*—One of the most common types of obstruction observed clinically results from the incarceration of a loop of bowel within the sac of a hernia, or beneath a band, or from torsion of a loop of bowel. The effect of either of these processes is to produce an impediment to the venous return from the loop, while the arterial inflow is not affected.

If a loop of bowel so chosen that its entire venous outflow is through one vein be isolated between ligatures, the vein divided, and the inflow tube of a manometer introduced into the distal end of the vein, it will be observed that the pressure registered by the manometer will shortly be equal to the systolic blood pressure. If the manometer be disconnected, and the experiment be repeated again and again, it will be observed that the manometer each successive time will register a lower and lower pressure, which it will reach after longer and longer intervals of time. This observation shows that the capillary bed of the bowel is subjected to the full force of the arterial pressure when its venous outflow is obstructed. The disastrous effect of this upon the capillaries can be seen when sections of a bowel which have been subjected to this process are studied under the microscope. It is not to be inferred, however, that the bowel cannot recover after having been subjected for some time to venous obstruction. Enderlen and Hotz<sup>1</sup> produced venous stasis in a segment of bowel by ligating the vein which drained it. When the congestion had become so great that blood had been extravasated beneath the peritoneum, they released the ligature. They found that the bowel had suffered no loss of absorptive power. This result harmonizes with clinical observation of the viability of bowel incarcerated in herniae.

Distention tends to protect the capillaries of a congested bowel against rupture because it increases the tension of the tissues around the capillaries. If the intra-intestinal pressure were equal to the systolic blood pressure there could be no venous congestion.

It is evident that early in the process of strangulation a bowel loses its contractility, and power of absorption. Strangulation is accompanied by a great outflow of bloody fluid and mucosal debris into the bowel lumen, and



by the exudation of bloody fluid in the peritoneal cavity. Since its circulation is obstructed, any absorption from a strangulated loop must be transperitoneal. It is well known that the bowel survives occlusion of both artery and vein longer than obstruction of the vein alone.

*Effect of Increased Peristalsis and of Perverted Vasomotor Function on the Circulation of the Obstructed Bowel.*—These effects are observed in the afferent loops of bowel. Low intra-intestinal pressure causes violent peristalsis which is accompanied by arterial relaxation and increased blood flow. These effects are to be regarded as exaggerations of normal functional activities of the bowel. The increased blood flow caused by low intra-intestinal pressure, in the presence of more or less venous obstruction, due to causes already mentioned, is probably the chief cause of the venous congestion often observed in the bowel above an obstruction. In one experiment (see Fig. 5) in which we were measuring the volume of blood flowing from a segment of intestine, we observed a considerable increase of flow while the bowel was contracting. It is probable that in the human intestine an intra-intestinal pressure of 10 to 15 Mm. of mercury will stop peristalsis. We have already shown that this pressure will decrease the volume of blood flowing through the intestine.

*Effect of Increased Intra-abdominal Pressure and of Impaired Systemic Circulation on the Circulation of the Obstructed Bowel.*—Increased intra-abdominal pressure theoretically should diminish the volume of blood flow in the obstructed bowel, but probably has very little effect. The reverse, however, is true of the effect of impaired systemic circulation. The low blood pressure and increased viscosity of the blood which are present in advanced intestinal obstruction, impairs still more the already deficient circulation of the bowel.

*Effect of Intestinal Distention upon the Intra-abdominal Circulation as a Whole.*—With its abdomen tightly closed, we inflated the entire small intestine of a large dog to the level of the systolic blood pressure. This increased the intra-abdominal pressure from zero to only 14 Mm. of mercury, and the blood pressure from 126 to 146 Mm. of mercury. Sudden deflation of the bowel caused these pressures to fall to their former levels. The elevation of the intra-abdominal pressure, because of bowel distention, will of course depend upon the amount of resistance offered by the abdominal walls.

Results of experiments on the intra-abdominal pressure, wherein the abdomen of the dog was distended, by the injection of normal salt solution, to a pressure equal to the systolic blood pressure have been previously published.<sup>11</sup> Under these conditions we demonstrated that all circulation through the abdominal viscera ceases, as shown by their being white and bloodless. With lower pressures we found that the intra-abdominal pressure and the pressure in the vena cava remain identical. This shows that the flow through the intra-abdominal veins when the intra-abdominal pressure is high is pro-

duced by the *vis à tergo* of the heart, which is transmitted through the capillaries. These are not ruptured because they are supported by the pressure around them.

It is possible that, under some conditions, the intra-abdominal pressure of a patient might reach a height which would produce considerable anemia of the abdominal organs, and that sudden release of the pressure might produce a failure of the circulation. Nothing of the kind appears in acute experiments on dogs, and we have never observed its occurrence in man, but it has been reported.<sup>12</sup>

Apparently the chief harm done to the circulation by increased intra-abdominal pressure is produced indirectly by interference with respiration and heart action.

*Effect of Intestinal Obstruction upon the Systemic Circulation.*—The discovery by Hartwell and Hoguet<sup>13</sup> that the parenteral administration of sufficient salt solution will prolong life greatly in the presence of intestinal obstruction is probably the most important contribution ever made to our knowledge of this disease. Preceding investigators had discovered that the body loses considerable fluid because of bowel obstruction, but Hartwell and Hoguet first recognized the great magnitude of this loss, and grasped its theoretical and clinical significance. Their discovery has finally led to the demonstration, now accepted by everyone, that the chief cause of death in simple obstruction of the small bowel, which in man usually means high obstruction, is circulatory failure due to loss of water and electrolytes by the blood. Death from this and from all other forms of obstruction was formerly attributed to the absorption of poisonous material from the bowel. This intoxication theory,<sup>14</sup> though now restricted in scope, is still believed to account for many of the systemic effects of all forms of obstruction which have *injured* the bowel. It has had great influence upon research and treatment, though its truth has never been proved. Many writers have pointed out that the crucial test of the proof must be the demonstration that toxic material is actually absorbed from the obstructed bowel.

The proof has been sought by many methods, but chiefly by methods designed to demonstrate the presence of toxic substances in the blood and lymph of animals with bowel obstruction. L. R. Dragstedt<sup>15</sup> has recently pointed out that poisons are so quickly neutralized or fixed by the body that attempts to recover them from the body fluids are likely to be failures.

Our experiments have enabled us at least to delimit the problem accurately. The following conclusions regarding its present state seem justified:

1. There are two possible ways for toxic material present in the lumen or wall of the obstructed bowel to reach the systemic circulation: (1) By way of the mesenteric vessels. (2) By way of the peritoneal cavity.
2. Before the passage of *any* toxins which we can imagine to be present by either route or under any conditions can occur, injury to the mucosa must exist.

3. Injury observed under clinical conditions to the mucosa of the obstructed bowel is due practically to two causes only: (1) Distention. (2) Venous congestion.

4. Any passage of toxins from a bowel with devitalized mucosa must be transperitoneal as long as its circulation is stopped by pressure or obstruction; by way of the mesentery if its circulation is present.

*Clinical Importance of Transperitoneal Absorption.*—Since various kinds of toxic material readily diffuse in vitro through the bowel wall after its mucosa has become devitalized, it is to be inferred that they do so under clinical conditions characterized by injury to the mucosa and arrest of the circulation by distention or venous obstruction.<sup>16</sup> There is good reason to believe, however, that the inflammatory reaction of the peritoneum around the affected loops can prevent the passage of the toxic material into the systemic circulation. The work of David and Sparks<sup>16</sup> on the protective action of peritoneal exudates gives strong support to this belief. It is also supported by the clinical observation of loops of bowel which evidently have been gangrenous for many hours and have caused no noteworthy systemic disturbance. The peritoneum probably can isolate a devitalized bowel as readily as it can on abscess.

*Clinical Importance of Absorption by Way of the Mesenteric Vessels.*—It follows, from the foregoing, that, under clinical conditions, the only time at which absorption of toxic material by way of the mesentery can occur follows the relief of venous obstruction or the relief of distention. This restores the circulation of the bowel and permits the blood to carry away any poison which has passed through the devitalized mucosa. Elman<sup>17</sup> has recently produced clinical evidence in support of the absorption of toxins under these conditions.

The blood flow through a strangulated bowel after the relief of the venous obstruction is probably so slowly reestablished that it carries toxins away gradually and in small amounts only. This idea is supported by the usual behavior of patients following the reduction of strangulated herniae. The sudden relief of the prolonged distention of long loops of bowel is theoretically a more serious matter.

#### CONCLUSIONS

(1) In clinical intestinal obstruction, injury to the bowel is due chiefly to distention and venous obstruction.

(2) Distention causes a decrease in the blood flow through the bowel wall, which is in direct proportion to the elevation of the pressure. It almost stops the blood flow when it reaches the level of the diastolic blood pressure. At this level it stops all absorption by way of the mesentery. Transperitoneal absorption then occurs.

(3) Distention sufficient to arrest the circulation of the bowel will devitalize the intestinal mucosa in from five to 15 hours. This devitalization is demonstrated by the loss of selective absorption by the mucosa. It

then permits the passage of toxic substances present in the normal and obstructed bowel.

(4) The absorption of materials normally absorbable by the bowel, except water and probably inert gases, proceeds at a relatively uniform rate in the presence of intra-intestinal pressures between zero and the diastolic blood pressure. Final conclusions on the effect of distention on the absorption of water and inert gases have not been made.

(5) Venous obstruction subjects the capillaries of the bowel to the full force of the systolic blood pressure. This accounts for its rapid destruction of the bowel wall.

(6) The circulation of the obstructed bowel is not greatly influenced by the increased intra-abdominal pressure which accompanies intestinal obstruction. The blood flow through distended loops must be lessened by any weakness of the systemic circulation.

(7) The conditions under which toxins can be absorbed from the obstructed bowel are stated, and the conclusion reached, that the body is protected in a fairly adequate manner from absorption of toxins by way of the peritoneum; also the conclusion that the sudden relief of obstruction in the presence of devitalized mucosa may permit the rapid absorption of toxic substances by way of the mesentery.

(8) In the clinical management of patients suffering from advanced obstruction, it seems desirable to deflate the bowel gradually before the operative relief of the obstruction is undertaken. Otherwise the barriers against absorption of toxins by way of the peritoneum, and against their rapid absorption by way of the mesentery, may be broken down.

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DISCUSSION.—DR. FREDERICK T. VAN BEUREN (New York, N. Y.).—The author's experiments are particularly interesting to me in view of some recent work that we have been doing to test the comparative toxicity of normal and obstructed intestinal contents. It is merely repetition of work that has been done before, a good many years ago, by a number of French and German investigators, and resulted in confirmation of their claim that the normal intestinal contents were just about as toxic as the obstructive contents.

If that is true and you have poison existing in the intestines before obstruction, why should it be absorbed after the intestine is obstructed and not before?

This work of Doctor Gatch is particularly timely and instructive from that point of view because he has shown so clearly the conditions under which absorption takes place and why. If there were some way in which we could remedy the situation, relieve the pressure under which mucosa is injured by the shutting off of its blood supply, we would have solved the problem of the treatment of intestinal obstruction.

It is important that the relief of the distention be made gradually, so as to prevent the absorption of poison with the released circulation after the mucosa has been injured by the prolonged distention. Whether we do that by a tube from above or from below, as he has pointed out, it is not effective unless the intestinal wall is still sufficiently viable. It is again another argument for the only really good treatment of intestinal obstruction which is early diagnosis and early operation to prevent the injury to the bowel.

DR. THOMAS G. ORR (Kansas City, Kans.).—Doctor Gatch has quite ably presented the physiologic and pathologic changes which take place in overdistention of the gut when the bowel is obstructed. I think it is, of course, obvious to everyone that we cannot cure intestinal obstruction until we have relieved the obstruction, but we can render considerable assistance by taking into account the physiologic and pathologic changes that take place during the progress of the disease, especially in simple occlusion of the gut.

It is probable that there are two lethal factors in simple obstruction, disregarding, of course, the strangulation of the bowel which adds still another. These two factors are the loss of essential secretion from the upper intes-



tinal tract and overdistention which Doctor Gatch has discussed. We have a means of eliminating in a measure the first, by supplying chlorides and liquids to replace those which have been lost by the disease. In the second situation, we have a condition which is a little more difficult to overcome, but we can assist by relieving the pressure within the gut mechanically with the suction apparatus which has been so ably presented by Wangensteen, and by enterostomy in selected cases. In addition we also may aid in maintaining the bowel tone during the height of the disease. We know that salt will stimulate peristalsis in concentrated solutions and there is no reason why we should not believe that, if maintained at the normal level in the body, it will aid in maintaining the tone of the gut. In addition to salt, we may assist in maintaining the tone of the gut by keeping the patient continuously morphinized. If the bowel is kept stimulated we may, during that stage of distention or beginning of distention, prevent to some extent the overdistention until we can relieve the obstruction.

Morphine, as you know, stimulates the tone and rhythmic contractions of the intestine. As long as there is activity of the gut, certainly there can be no absorption of toxins. In other words, the gut that still maintains its activity will absorb those things it should absorb and not absorb those things that it should not absorb.

DR. JACOB FINE (Boston, Mass.).—There are three sources from which gases causing bowel distention are derived.

Some ten years ago, McIver, in a clinical study, demonstrated that at least in postoperative patients swallowed air accounted for the major portion of the distending gases and recommended the use of an inlying stomach tube as a prophylactic for intestinal distention.

From some recent experimental studies done at the Beth Israel Hospital, we have concluded that the type of food ingested will account for some of the intestinal gases. Thus pure proteins and fats such as lean meat, gelatin, olive oil, *etc.*, do not generate significant volumes of gas in a closed loop consisting of stomach and small intestine. Similarly certain carbohydrates such as cooked cereals and toast are innocuous. But liquid carbohydrates, such as orange or grape juice, milk, custard and puréed vegetables, such as lima beans, are especially rich sources of gas formation. Of the gases which are generated in the gastro-intestinal tract  $\text{CO}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{O}_2$  and  $\text{CH}_4$  are of little consequence in distention because the first two,  $\text{CO}_2$  and  $\text{H}_2\text{S}$ , are absorbed very rapidly unless the circulation of the bowel wall is badly damaged, while the latter two,  $\text{O}_2$  and  $\text{CH}_4$ , are almost never found by analysis to constitute more than an insignificant percentage of the volume of distending gases.  $\text{N}_2$  from swallowed air and  $\text{H}_2$  formed from the fermentation of foods constitute the bulk of the distending gases because they are not readily absorbed by the blood stream. The amount of  $\text{H}_2$  in any given instance will depend on the type and quantity of food in the intestine at the moment when peristaltic activity becomes inadequate for the expulsion of intestinal contents.

The third source of gases in the intestine is the nitrogen in physical solution in the blood. This nitrogen diffuses into the intestine from the blood until the partial pressure of nitrogen in the intestine reaches the same level as exists in the blood. When the intestine becomes inflated by nitrogen from swallowed air its pressure within the intestine is already equal or greater than it is in the blood. But any stretching of the bowel lumen by other gases such as  $\text{H}_2$  decreases the partial pressure of nitrogen in the intestine and so facilitates the entrance of further nitrogen into the gut from

the blood. This third source of nitrogen will not enter as a factor so long as the intestine contains no food. Experimentally we have repeatedly found that if a starved animal has the cardia and ileocecal valve ligated, no gas will accumulate in the stomach or small intestine. Consequently the ideal treatment for the avoidance of intestinal distention is (1) to use a stomach tube to prevent swallowed air from entering the duodenum; and (2) to avoid gas forming foods.

In the treatment of established distention which has failed to yield to the ordinary methods in common use, we have made use of an experimental observation by McIver to the effect that the absorption of nitrogen from the intestine can be accelerated by causing the animal to breathe pure oxygen. This is based on the well substantiated belief that nitrogen is the chief gaseous constituent of the distended bowel. The exclusion of nitrogen from the inspired air results in a rapid reduction of the pressure of nitrogen in the blood with a corresponding increase in the speed of diffusion of nitrogen from the intestinal lumen into the blood. We have applied this principle to eight patients with obstinate distention and believe we have accomplished a significant deflation of the gut. The use of pure oxygen for this purpose must be resorted to with due regard for its toxic properties, which can be avoided.

Of course, the principle underlying the use of oxygen would apply for the removal of incarcerated air anywhere in the body. We are now attempting to utilize the method for the relief of symptoms following the introduction of air into the ventricles for encephalographic examination. Preliminary observations so far are quite encouraging and we have roentgenologic evidence showing the absorption of air from within the cranium under these circumstances. The application of the principle for the relief of subcutaneous emphysema and for certain types of pneumothorax might also be considered.

In connection with Doctor Gatch's statement regarding the failure of fluid to accumulate in a loop of gut distended with air, we have repeatedly distended collapsed loops of gut with various gases under considerable tension and within 12 to 24 hours have frequently recovered variable quantities of fluid.

As to the viability of the gut distended with gas we can state from our experimental observations that loops of gut so distended under pressure equal to or exceeding what is encountered in long standing obstruction may remain perfectly viable after 24 hours even though the pressure remains high.

DR. OWEN H. WANGENSTEEN (Minneapolis, Minn.).—The very splendid paper of Doctor Gatch could not be discussed with justice in a few minutes. My colleagues and I have experimented along somewhat similar lines and by and large our results are much the same. When the bowel is obstructed, it shortens, increases in weight, and its strength diminishes. The stress upon the bowel wall in obstruction may readily be calculated from the formula—stress or tension is equal to the circumference of the bowel multiplied by the sustained intra-enteric pressure, or  $T = D \times \text{Pi} \times \text{Pr}$ . We have determined the intra-enteric pressures in established obstructions of the small bowel in about 40 dogs. Similarly, the intra-enteric pressure has been measured in several instances of obstruction of the small intestine at the time of performance of enterostomy and upon the obstructed colon, when decompression was established by colostomy. In the experimental obstructions of the small intestine a mean sustained intraluminary pressure of about ten cm.

of water was observed—a finding in keeping with the intra-enteric pressures noted in instances of clinical obstruction of the small intestine. Occasionally, intra-enteric pressures as high as 16 to 18 cm. of water were encountered. In clinical obstructions of the colon with considerable distention, on the contrary, high intra-enteric pressures are the rule. Pressures varying between 12 and 52 cm. have been observed with a mean value of about 24 cm. The proximal competent ileocecal sphincter makes of the colon a virtual closed loop, in which loop a high pressure usually develops.

In this behavior lies a fundamental difference in the manifestations and sequence of events which attend obstructions of the small intestine as distinguished from those in the colon. In obstructions of the small intestine, regurgitation occurs into more proximal reaches of the bowel and also the stomach. In consequence, vomiting is a prominent feature. Because of the participation of several loops of bowel in the distention, the intra-enteric pressure is not as high as it would be, were the distention confined to a relatively short segment, as it is in the obstructed colon. When a duodenal tube is passed into the stomach, when the small bowel is obstructed, a high grade of gastric retention is usually found.

When the colon is acutely obstructed, there may be no vomiting despite enormous distention. In a patient exhibiting intestinal colic with considerable distention, but no vomiting, obstruction of the colon is to be suspected. Fecal-like vomiting denotes obstruction of the small intestine.

The hazard borne by a patient with an obstruction of the colon is immediately apparent in the stress upon the bowel wall. There often is no fluid loss in such a patient and gastric retention is rarely found. The administration of saline solution, which is so helpful to patients with high obstruction of the small intestine in which the fluid loss is great, has no particular virtue in colonic obstructions. Frequent vomiting in small bowel obstructions helps to reduce the intra-enteric tension and consequently the stress upon the bowel wall. The obstructed colon may perforate even though the patient does not appear especially ill.

The clinical axiom that the high small bowel obstructions are the most dangerous should be altered to read: "Low obstructions are the most treacherous for they carry the greater hazard for the safety of the bowel wall." Apart from the item of fluid loss, which concerns essentially only high small bowel obstructions, the important consideration is relief of the obstruction before the viability of the bowel wall has become impaired.

## MESENTERIC VASCULAR OCCLUSION

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OCCLUSION of the mesenteric vessels may involve the arteries or veins, or both. In an analysis of 36 cases on which autopsies were performed, reported from the Mayo Clinic by Larson<sup>1</sup> in 1931, the occlusion was arterial in 39 per cent, venous in 44 per cent and coexistent venous and arterial in 17 per cent. The occlusion may occur in the main stem of the vessels, in a branch supplying one intestinal loop or in the vessels close to their distribution in the intestinal wall. A vascular lesion may be due to a thrombus or an embolus, or a thrombosis and an embolism may occur in combination. The closure of the vessel may be complete or incomplete. If the obstruction to the circulation is sufficient to destroy the blood supply of the intestine, it results in gangrene of the intestinal wall. If it is not complete a hemorrhagic infarction may occur in the intestinal wall and mesentery, which may progress and may eventuate in gangrene; or the circulation may be reestablished with recovery. Anemic infarct rarely occurs.

Although occasional reports appear in the medical literature of cases of vascular mesenteric occlusion which recover spontaneously after nothing more has been done than an exploratory operation, and also reports of recovery after very extensive intestinal resection, the mortality is frequently said to be in the neighborhood of 90 per cent. Therefore, quite naturally, the prognosis in all cases is a gloomy outlook.

It is obvious that an occlusion of the main stem or branch of the superior mesenteric artery or vein, which would destroy the blood supply to a large portion of the small intestine, would give small opportunity to effect a surgical cure. If it is recognized that in a certain proportion of cases the occlusion occurs in one of the smaller terminal branches, allowing a resection, then a cure in such patients may be effected.

A review of the case histories of this disease from the records of St. Luke's Hospital was prompted by a recent case, in which not only a positive diagnosis of mesenteric thrombosis could be made, but also the location and the extent of the lesion was demonstrable by a plain roentgenographic film of the abdomen, and the operation showed that previous to the attack an earlier incomplete occlusion had occurred, or the circulation had been reestablished.

There were 11 patients whose histories were filed under the diagnosis of "mesenteric vascular occlusion." Of these, seven died and four recovered. A resection of the intestine had been performed upon three of the four who recovered. In the fourth patient, while there was bloody fluid in the peritoneum and a hemorrhagic area in the base of the mesentery, the circulation of the intestine did not appear to justify a resection. In the seven fatal

cases a resection was done in one only, an ileostomy in one, and no operative procedure was performed in the others.

A comparison of 36 pathologic reports, published in Larson's<sup>1</sup> article, with the limited number of autopsy reports or examinations of removed specimens in St. Luke's Hospital, is of interest. In Larson's series a vascular occlusion was noted in every case. In the St. Luke's Hospital series this was not so. In one case in which postmortem examination was performed, there was gangrene from the beginning of the jejunum to and including the cecum and appendix. The pathologic report stated that: "There is marked constriction about the opening of the superior mesenteric artery and celiac axis which contained some atheromatous patches. No thrombosis is present in the superior mesenteric artery or vein." In a second case the report stated that: "The intestine is necrotic and sections showed infarction and hemorrhage, but the arteries do not contain thrombi (32 cm. of small intestine had been removed in this patient)." In a third case: "Postmortem shows that four feet above the ileocecal valve there is a V shaped area in the mesentery about 4 centimeters wide with areas of hemorrhage and edema. The intestinal wall is hemorrhagic but not necrotic. The vessels apparently are patent, and there are multiple subserous hemorrhages of the small intestine (an ileostomy had been performed on this patient)." In a fourth case, in which 18 feet of small intestine were resected, examination of the specimen removed showed that the intestine had areas of subserous hemorrhage, but apparently the vessels were normal, not showing thrombosis or any evidence of the etiologic factor of the process. In two cases, one of which recovered, one of which died, there was a thrombosis of the mesenteric vessels.

These pathologic reports, showing no gross thrombosis or embolism in the larger vessels, although there was gross damage to the intestinal wall, would suggest that in a certain number of cases the infarction began in the smaller vessels, either close to or in the vessel wall, in some instances perhaps being due to an anaerobic infection originating in the intestine itself. It also is of interest in making this comparison of the small group of cases from St. Luke's Hospital with Larson's group from autopsy reports, that the former were operated upon for primary vascular occlusion while five of the latter group were complicated by extension of an infective process in the appendix with development of a septic thrombus into the tributary veins. There were also two postoperative occlusions following intestinal obstruction, in which the thrombus resulted secondarily to damage to the intestine or its mesentery.

An examination of the St. Luke's histories suggested nothing which would aid in making a preoperative diagnosis any easier. A recognition of what are known to be the etiologic factors in mesenteric vascular occlusion, such as an arteriosclerosis, atheroma, cardiac disease or aneurysm, abdominal trauma, a previous history of phlebitis or polycythemia, or a chronic sepsis, might suggest that in the presence of acute abdominal symptoms mesenteric



occlusion was the causative factor. But it is questionable whether a correct preoperative diagnosis is made any more frequently now, than when Trotter in 1913 analyzed 360 cases in which he stated that the preoperative diagnosis was made in only 13.

One would expect to find these lesions occurring in the later age groups where arteriosclerosis is common, but cases have been reported where the patients were eight, ten and twelve years old, and one case at four months. A chronic sepsis may be the etiologic factor and in one case from the St. Luke's series, a complete mesenteric thrombosis occurred following an abdominal contusion five months after a splenectomy had been performed for Banti's disease.

However, one would not expect to be able to formulate a definite symptom complex when the pathologic condition may vary from an occlusion causing extensive interference with the circulation of many feet up to the entire length of the small intestine; or only affect one small loop; or where the vascular occlusion may be immediate in its result or, in other cases, progressive. In the majority of instances the symptoms will be those of an acute abdominal catastrophe, indicating an exploratory operation, and the abdominal pain, which is a predominant symptom of all such cases, would be common to a mechanical obstruction, a volvulus, an intussusception, a malignant lesion, rupture or perforation of an abdominal viscus or an acute pancreatic necrosis.

It is unnecessary here to recapitulate the percentage of frequency of the various other accompanying symptoms, which have been carefully analyzed and reported in an article by Meyer in 1931. When the symptoms, which point to an acute abdominal catastrophe, are a high leukocyte count together with acute abdominal pain, a previous history of thrombosis or a source of embolism, an early subnormal temperature, abdominal rigidity and melena, one has a definite group of symptoms pointing to a mesenteric occlusion. However, Meyer in his review of 92 proven cases—which had been reported during the previous ten years—states that melena is reported in only 14 per cent of the cases and that in three of these it did not occur during the first 24 hours, in one instance not appearing until the twelfth day. The same thing applies to rigidity which may or may not be present, depending on the amount of bloody fluid exudate which occurs. In none of the 92 cases was a radiogram to determine the presence of gas recorded. A definite preoperative diagnosis rarely can be made in the early stage of the disease, beyond the recognition of an acute abdominal lesion requiring an exploratory operation, except in the very favorable case such as is reported in this article.

Having determined that an exploratory operation is indicated, it becomes necessary to recognize the abdominal lesion present, or in the process of development, and to determine the operative treatment indicated. It must be recognized that recovery may take place in what appears to be a badly damaged loop of intestine. Also it must be recognized, especially in cases where there is thrombosis in the veins, that if no resection is done the thrombosis may progress and result in further intestinal damage. Cases are re-

ported from autopsy where the condition was not recognized at operation, perhaps because there was an early stage of a progressive lesion, which went on to a fatal termination.

The color of the intestine alone is insufficient to determine its viability. It may be of some assistance to puncture a small vessel in the mesentery near the intestinal wall with a needle to see if blood still escapes from the needle prick, and careful observation of the circulation of the mesentery will be a valuable guide to determine the point of resection. Cases are recorded where apparently extensive damage to the whole small intestine was present and where without resection the patient has recovered. This can be explained only by the fact that there was a mistake in judgment as to the extent of the damage, or recognition of the possibility of restoration of the circulation. Other cases are recorded where recovery has occurred after very extensive intestinal resections.

In the series of 92 cases reported by Meyer, there was a gross mortality of 57.6 per cent, but in 43 of these cases in which partial resection was done the mortality was 32.6 per cent. In 11 cases examined from the St. Luke's series the mortality was 63.6 per cent, one case having recovered without any operative procedure beyond an exploratory operation, but in the four in which resection was done three recovered, making a mortality of 25 per cent.

In a number of cases reported in the literature either an enterostomy or an exteriorization was done. These procedures have little to recommend them. If the occlusion is sufficient to damage the intestine, the enterostomy will not remove the area which is going on to necrosis and become gangrenous and, even apart from this, Mason has called attention to the potency of fresh tissue extract in the production of intravascular coagulation (thrombosis or embolism). As to exteriorization, if all of the loop can be brought out of the abdominal cavity to be exteriorized, very little more time would be required with additional strain on the patient to remove the diseased portion and to perform an anastomosis and at the same time to excise the thrombosed mesentery and prevent the extension of the thrombosis. The reports of cases from the literature confirm these theoretical considerations. Therefore it would appear that, both from a theoretical viewpoint as well as from case reports, where possible a resection and immediate anastomosis should be done. As there are symptoms of obstruction in these cases without occlusion of the intestine, one does not find a large, dilated loop above the portion of the intestine resected with a small, contracted loop below and, therefore, this difference in caliber of the intestine does not have to be considered. Having determined the extent of the damage to the bowel and by careful examination of the mesentery how far the thrombosis or damage to the mesentery has extended, a resection of the damaged bowel and its corresponding mesentery should be done, with immediate anastomosis by the aseptic method.

A report of the following case is of special interest because, as before stated, the previous history, the presence of blood in the stool and the

plain roentgenogram, demonstrating the loop of the intestine involved, made possible a preoperative diagnosis not only of mesenteric thrombosis but determined the site of the operative incision, location of the lesion and extent of the bowel involved; and demonstrated at operation an area which previously had been the seat of a thrombosis of the mesentery, with return of the circulation and recovery of the intestinal wall.

#### CASE REPORT

L. R., male, age 37. Admitted to St. Luke's Hospital March 27, 1934. He had been operated upon in another hospital the previous January for appendicitis. This was followed by a pulmonary infarction and later by a double femoral phlebitis. He remained in the hospital until the early part of March when he returned to his home.



FIG. 1.—Plain roentgenogram film showing loop of damaged small intestine in left lower quadrant.

Shortly after his return home he began to have lower abdominal pain which gradually became more severe, was accompanied with distention and vomiting and signs of a partial obstruction. These symptoms gradually became more severe up to the time of his admission to St. Luke's Hospital. There were no signs of an acute obstruction and a plain roentgenogram of his abdomen on admission showed a general distention of both the small and large intestine. His preoperative temperature ranged from  $98\frac{2}{5}^{\circ}$  to  $100\frac{4}{5}^{\circ}$  and at the time of operation was  $98\frac{2}{5}^{\circ}$ . On the morning of April 1 his pain became more severe, tenderness more marked and an enema was followed by a very considerable amount of blood in his stool. The plain roentgenogram (Fig. 1) of his abdomen taken at this time showed a somewhat contracted loop of intestine in his left lower quadrant, and there was some rigidity and marked tenderness over this area. A

## MESENTERIC VASCULAR OCCLUSION

diagnosis of thrombosis of the mesentery with damage to the intestine was made. He was operated upon immediately under spinal anesthesia. The incision was made in the left lower rectus region, which had been indicated both by tenderness and the roentgenogram. Upon opening the abdomen, there was some bloody peritoneal fluid found, and a loop of the ileum about 60 cm. in length, which was dark red to deep purple in color, was delivered. The mesentery was very much thickened and the vessels contained thrombi down to the base of the mesentery. Ninety-five cm. of intestine were removed leaving 15 and 18 cm. of normal intestine at each end. A corresponding section of mesentery was removed, and it was of interest that, on removal of the clamp from this portion of the mesentery, it could be seen that all of the veins were occluded by thrombi. An end-to-end anastomosis was done by the aseptic method. On examining the intestine above and below the damaged area there could be seen a second area about 30 cm. below the area previously described, which was thickened and grayish and resembled a loop of intestine which had been partially occluded in a strangulated hernia. On holding the mesentery of this loop up to the light there could be seen apparently newly formed vessels and it was evident that this area previously had been damaged by a thrombus during the period of two weeks when he first had his symptoms at home, which resembled a partial obstruction and from which he had recovered previous to the development of this new thrombosis. The patient had a stormy convalescence and at times it appeared that he might be developing new thrombi. He finally recovered and left the hospital on June 6 and has had no symptoms since then.

The pathologic report showed that the blood vessels were blocked with septic thrombi, there were no changes in the arteries, and that the obstruction of the veins was evidently due to infection.

No blood culture was taken, but after operation when it was feared that he was developing further thrombosis his bleeding time was 2 1/2 minutes, coagulation time 4 1/2 minutes. Blood calcium 10 and blood phosphorus 3.8. All normal values. During this time he was on a diet low in protein and calcium and high in carbohydrates. Whether this influenced his convalescence cannot be determined.

### SUMMARY

An examination was made of the histories of 11 cases of mesenteric vascular occlusion from the records of St. Luke's Hospital. Of these, seven died and four recovered. A comparison of the pathologic findings from specimens which were removed or autopsy reports was made with a report of 36 autopsy studies from the Mayo Clinic, reported by Larson. The difficulty of formulating a definite symptom complex in a condition in which the pathologic lesion may be so different is called attention to, and also an attempt is made to call attention to those symptoms which, in the presence of an acute abdominal catastrophe, would indicate the probability of mesenteric vascular occlusion.

More favorable mortality statistics, both from the literature and from the small group of cases reported from the St. Luke's Hospital records, would seem to indicate the advisability not only of an early operation but of the carrying out of an immediate resection and anastomosis rather than an ileostomy or exteriorization as a palliative measure.

A case is reported which gives a previous history of thrombosis and which later developed blood in the stool, and in which a plain roentgenogram demonstrated the loop of intestine involved which not only made a preoperative diagnosis possible, but determined the location of the operative incision and the extent of the bowel involved. Operation also demonstrated the site of

a previous incomplete vascular occlusion to another loop of intestine, in which circulation had been reestablished.

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DISCUSSION.—DR. HENRY W. CAVE (New York). Doctor Douglas has stated that in addition to circulatory diseases such as arteriosclerosis, atheroma, aneurysm, and endocarditis, trauma is an important etiologic factor in mesenteric vascular occlusion. He also brought out the point that it is very important to make thorough roentgenographic studies of these cases before operation, all of which I am in accord with.

I should like to recite a case where a preoperative diagnosis of mesenteric thrombosis was made which was due to trauma. A man of forty-two, a splendid athlete and a famous polo player, complained of distress in the right upper quadrant of his abdomen, with increasing distention. His previous history was unimportant except he had had an appendectomy in 1908 and typhoid fever in 1913. His present illness began on June 9, 1931, just four years ago.

While attempting to lift up the rear end of a stalled automobile, he experienced a sudden pain in his abdomen with a feeling as though something was giving way. He walked back to the house, crawled through an open window and lay on the floor all night. The only comfort he obtained at all was when he crawled around on his hands and knees. He became rapidly more ill and his abdomen became more distended. I saw him three nights and two days following the onset of his illness. At that time his abdomen was markedly distended. There was a scar of his previous operation. He was tender; there was visible peristalsis. A diagnosis of intestinal obstruction was made, due possibly to an intraperitoneal band at the site of his old appendix wound. This was later altered after examination at the hospital to a diagnosis of mesenteric thrombosis.

At operation the last four feet and nine inches of his ileum was practically black, deep purple. The leaves of the mesentery had been forced apart and were tremendously swollen by the influx of blood. The intestine was resected and an end-to-end anastomosis with a proximal enterostomy performed. He made a satisfactory recovery.

Another extraordinarily extensive mesenteric vascular occlusion was found in a woman, 48, a patient of Dr. William C. White's, who had suffered from thyrotoxicosis, with an enlarged heart, endocarditis and a history of 24 hours of severe abdominal pain with nausea and vomiting.

She, too, had been operated upon for some abdominal condition and appendix some years ago. We considered the diagnosis of band with obstruction or, more likely, mesenteric thrombosis. She was operated upon immediately and an extraordinarily extensive dry gangrene was found starting about six inches below Treitz' ligament, throughout the entire small intestine, through the ileocecal valve, head of the cecum, and quite far up the ascending colon. She died shortly afterward.

A partial autopsy demonstrated a saddle thrombus in the superior mesenteric artery, at the ileocolic branch, which hardly seemed to account for the very extensive dry gangrene of this part of her small intestine, but such was the case.



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A third interesting case (courtesy of Dr. H. A. Patterson) was that of a young boy, 22, who had had an acute gonorrheal arthritis with epididymitis for five weeks. He ate a big meal one night and became desperately ill. On entrance to the hospital, a mass in the right lower part of his abdomen was apparent. He passed some blood, was nauseated and vomited. A diagnosis of intussusception was made. At operation he showed a most interesting segmental area of gangrene in the ascending colon above the head of the cecum. A colectomy was performed, side-to-side anastomosis. He made a satisfactory recovery.

At Roosevelt Hospital we have had 12 cases of mesenteric vascular occlusion proved at operation. Four lived, eight died, a mortality rate of 66.6 per cent. I should like to say I agree heartily with Doctor Douglas' statement that the operation of choice in this condition is certainly immediate resection and preferably enterostomy above. I think any other operations usually prove fatal.

DR. EMMET RIXFORD (San Francisco, Calif.).—There are several possible etiologic elements that apply to individual cases of mesenteric vascular occlusion. We have opened the abdomen a number of times and found local congestion of the small bowel with evident inflammation and one suspects that sometimes in these cases the mesenteric vessels are occluded, in some cases by arterial emboli, in others thrombosis of the mesenteric veins resulting from ulceration in the inflamed segment of the gut, most commonly of course in acute appendicitis, the most frequent cause of portal embolism.

I would like to put on record two extreme cases in point, which occurred in 1901:

A young man of 35, on getting up from a chair, was suddenly seized with an extremely severe, agonizing pain in the chest. He was given morphine up to one Gr., without relief. He then received nitroglycerin 1/100, following which pain subsided temporarily. At 4:30 A. M. patient was seen by me; pulse 140; respiration 30; patient in great agitation; abdomen distended, moderately rigid; no sound of peristalsis. In an hour pulse had increased to 150. Leukocytes 27,000. 10 A. M. exploratory incision showed the entire midgut necrotic and flaccid. Patient expired about 1 P. M. Autopsy showed a small perforating ulcer, doubtless syphilitic, in the arch of the aorta, producing a dissecting aneurysm, the adventitia of the aorta being dissected off the muscular coat as far as the iliac veins. The mesenteric obstruction was complete, produced by the pressure of the blood between the adventitia and the muscularis.

Quite in contrast to this case was that of a banker, aged 53, with presumed gallstone colic. His physician advised operation. Patient demurred, asked could not something else be done. The physician said, "Yes, you might go to Carlsbad." He went to Carlsbad and took the "Kur." He returned quite relieved. He had hardly reached home when he had another attack. A second visit to Carlsbad relieved him of his pain. A few months later he became suddenly distended, and had very acute pain. Operation showed a large part of the small intestine thickened, congested and cyanotic, a large amount of bloody serum free in the peritoneal cavity. The mesentery was ligated and the loops of small bowel hung out of the wound as in the Mikulicz technic, the patient being in such desperate condition that resection seemed contraindicated. He died the next day. Autopsy showed pancreatitis with fat necrosis which had encroached upon the mesenteric vein near its junction with the splenic so that the vein was no larger than the lead of a lead pencil, and this was obstructed by a small clot.

DR. ALTON OCHSNER (New Orleans, La.).—An insufficiently appreciated cause of mesenteric thrombosis of venous type is that associated with prolonged ingestion of alcohol. Doctor Storck, in our clinic, has had five cases occurring in young individuals in whom a venous mesenteric thrombosis had

occurred following prolonged imbibition of alcohol. In two of these, diagnosis was not made preoperatively, but in three the diagnosis was made. Prognosis in this type of case is good. The only fatal case we have had was a case in which we did resection. The other four cases were operated upon, but no resection performed. All recovered.

DR. FREDERIC W. BANCROFT (New York).—Doctor Douglas has presented a vivid picture of a severe and tragic catastrophe.

I was particularly interested in the cases presented where autopsies had been performed and there was no real vascular occlusion noted. I wonder if there may not be another explanation in addition to the one given by Doctor Douglas. In opening an abdomen through a small incision in the early exploration of an intestinal obstruction it is easy to liberate a band or to replace a volvulus without the operator being certain that he has done so, and it may be that in some of these cases there was an actual mechanical obstruction of the vessels. This mechanical cause may have been pressure on the vessels from without—and not occlusion from within by thromboses.

The percentage of correct preoperative diagnoses should be higher if our knowledge of the pathology is correct and we analyze our physical findings. After the thrombosis occurs the intestinal wall becomes edematous and swollen, with a lumen containing hemorrhagic fluid and very little gas. A flat roentgenogram taken at this time will show an abdomen with the intestines full of fluid, in contradistinction to the usual obstructive case where gas forms a large part of the intestinal contents. Physical examination will reveal a flat abdomen on percussion, and on auscultation no peristalsis can be detected. One has then the picture of a paralytic obstruction. Doctor Pound of the Fifth Avenue Hospital has made the positive diagnosis of thrombosis by the roentgenologic evidence presented in three cases. It is a principle in medicine that where there is a definite reaction of hyper- or hypoactivity, the opposite will be found: That is, we find cases of hyperthyroidism and hypothyroidism, of hyperacidity and hypoacidity, of hypertension and hypotension.

It is admitted generally in medicine that there are potential intravascular bleeders. This is noted particularly in thrombocytopenic purpura, in some of the leukemias, and also in obstructive jaundice. If this be true, there should be then cases which are potential clotters.

About seven years ago Dr. Stanley Brown and I started a study of the blood clotting elements of patients, both pre- and postoperative, to see whether we could determine by blood examinations if such patients might be liable for thromboses. Our first tests were very cumbersome and could not be carried out by a regular hospital clinic. However, through the aid and advice given us by Dr. Armand Quick, who worked for two years on full time on this problem, we have suggested a test which we believe is simple enough for any hospital and which we believe gives a fairly accurate account of the patients' clotting tendencies. In studying these cases we have found that sodium thiosulphate given intravenously, and a diet low in proteins and fats, is of distinct prophylactic benefit. As an example of repeated embolism I might cite a case which had been operated upon three times previously and following each one of these operations the patient had developed phlebitis associated with emboli. She was prepared for a fourth operation by a diet low in proteins and fats and with sodium thiosulphate and went through this procedure without any accident ensuing.

It is our opinion that a prophylactic regimen can be utilized which will diminish the percentage of this accident. We wish to emphasize, however, that we believe that trauma, slowing of the blood stream, dehydration and infection are the most important factors to be avoided.

## RESULTS OF SPLENECTOMY IN CHILDHOOD

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INASMUCH as the vogue for splenectomy in various conditions is undoubtedly increasing, it seems worth while to discuss briefly the indications which one meets for this operation in childhood and the results which one can hope to achieve. In general, it may be said that these indications have all been arrived at empirically by trial of operation rather than from any previous definite knowledge of the etiology of the various conditions. The indications may be considered as falling into four separate categories, aside from the rare primary tumors which are occasionally encountered. These are:

- (1) To put a stop to a perverted pernicious activity of the spleen which may be designated hypersplenism.
- (2) To check the progress of some little understood pathologic changes in the splenohepatic circulatory apparatus.
- (3) To rid the body of an organ grossly enlarged and rendered useless by disease.
- (4) To remove a lurking place for certain types of infection.

Under some conditions more than one of these indications may be met by the same operation. We shall consider the application of these indications in the various classes of disorders in which the operation has been found useful.

*Constitutional Hemolytic Anemias.*—There are four diseases in this group which are of importance in childhood: hemolytic icterus; sickle-cell anemia; erythroblastic anemia and erythroblastosis of the new born. Splenectomy has been performed often in the first three of these disorders, only occasionally in the last.

*Hemolytic Icterus.*—This is a condition in which splenectomy has scored its greatest successes and in which it is usually regarded as the best method of handling the disorder and as being almost certain in its results. There is little occasion for comment on the disease itself, whose clinical picture is well enough known. There are some questions, however, regarding the most favorable time for operation and regarding the possibility of failures. As to the time of operation, it has been generally believed, in regard both to this disease and to other diseases in which there are crises of blood destruction, that it is unwise to operate during a crisis. We have followed this rule in our own clinic so far as possible, and on two occasions, to be spoken of later, when we have departed from it we have met with disaster. Recently Doan, Curtis and Wiseman have reported excellent results from operations

performed during the crisis, utilizing, of course, a very careful technic and having due regard to all possible risk. We still think, however, that this is so far as possible to be avoided, although we should feel encouraged by their paper to undertake the operation rather than submit the patient to the possible danger of going through a very severe crisis. In general we feel that it is better when, as often happens, we see the patient for the first time in the course of a crisis to wait until the crisis is over and the blood has come back to a fairly good level of red cells and hemoglobin before performing the operation.

Our records show six operations on children with this disorder which in all but one of the cases was definitely of the hereditary type. In the one exception there was a strong family heredity of pernicious anemia, but the child had a typical hemolytic icterus. In all of these cases, so far as we are able to ascertain at present, the operation has resulted in a complete cure of the primary condition. One of the patients has had, since her operation, some trouble from gallstones, a common complication, and recently has developed symptoms of duodenal ulcer. We have seen none of the recurrences of jaundice and anemia, which are occasionally reported, though we have been on the lookout for them, especially in cases where supernumerary spleens have been found and removed at the time of operation, as we have believed that the development of such a spleen would be a very likely cause for the return of symptoms in the occasional case.

*Sickle-Cell Anemia.*—This is another of the chronic hemolytic anemias of childhood which is accompanied by splenomegaly and which has, superficially, a very considerable resemblance to hemolytic icterus. The success of splenectomy in hemolytic icterus has led to a number of trials of the operation in this disease. There is, however, ample evidence that in sickle-cell anemia the disorder involves a greater part of the reticulo-endothelium than is involved in hemolytic icterus, in which from the results of splenectomy one might fairly conclude that the spleen is the organ which is almost entirely responsible for the blood destruction. We have not believed that in sickle-cell anemia one could expect a cure or any marked alleviation of the anemia. We have, however, performed the operation a number of times in the hope of relieving certain special symptoms.

Two of the troublesome symptoms in sickle-cell anemia are the crises of abdominal pain, which resemble quite strongly the crises of hemolytic icterus but are more often accompanied by definite splenic thrombosis; and recurrent attacks of pain in and around the joints which have never been satisfactorily explained. We have performed splenectomy on four cases of sickle-cell anemia in an effort to relieve some special symptom.

In the first case, the reason was the frequency of hemolytic crises accompanied by abdominal pain. This child has been observed over a period of some six years since the operation and while her anemia has not been particularly improved she has been practically entirely free from the crises and the pains.

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In the second case, while there were rather marked abdominal crises the chief difficulty was with the joint pains. In this case, since the operation was performed about three and one-half years ago, the patient has been, according to her own and her parent's statement, entirely free from the joint pains, although here again there has been only very slight improvement in the anemia since the operation.

In our third case, the patient had, in addition to joint pains, periodic convulsive attacks of an epileptiform type of whose causation we did not feel perfectly certain, but inasmuch as cerebral accidents have been reported a number of times in patients with hemolytic icterus and sickle-cell anemia there seems to be reason to suppose that they are related to the disease process. In this case the boy, during the year's observation after splenectomy, has had no trouble with the exception of one mild attack of abdominal pain. Here again the course of the anemia itself is not perceptibly changed by the operation.

In the fourth case, the patient was operated upon shortly after an attack of splenic thrombosis, and an enormous spleen was removed of which nearly one-third was taken up by a large fresh infarct. The patient died in shock shortly after the operation but as an autopsy was not permitted we do not know whether this may not have been the result of hemorrhage from the vessel stump. It does not seem likely that it was the result of operation during a crisis, as the crisis apparently was over and the blood on the upgrade at the time of operation.

We have said that the course of the anemia has not seemed to be appreciably improved following the operation. This has been our impression so far as our own cases are concerned. In other clinics around the country the feeling seems to be that the patients do somewhat better when the spleen has been removed.

We have had some experimental indication of a possible reason for this. We have thought that an important factor in the pathogenesis of this disease must be a peculiar physiochemical structure of the red blood cells. In some studies of the lipid makeup of the cells in the hemolytic anemias we have found that in sickle-cell anemia the lipids are definitely abnormal before splenectomy but show a return toward normal after the organ has been removed. Whether we may find a similar thing to be true of the protein constituents of the cell we do not yet know.

*Erythroblastic Anemia.*—This is an essentially chronic anemia peculiar to children of the Mediterranean races which almost invariably results fatally within the first ten years of life. It is characterized by a gradually enlarged liver and spleen, marked marrow hyperplasia and a great number of imperfectly formed red cells in the blood stream. There is no reason to suppose that the spleen plays any important part in the causation of the condition and its enlargement is probably almost entirely secondary. The organ becomes so large, however, that it seems worthwhile to remove it simply to relieve the child of the burden of its great weight and the operation has



actually been performed in most of the reported cases. We believe the general experience has been the same as ours—that there is no particular change in the anemia after the operation with the exception of the appearance of a remarkable number of nucleated red blood cells which persist for a period of years after the splenectomy. We have felt so far as our own cases are concerned that the patients were more comfortable and lived somewhat longer after splenectomy than we should have expected without the operation. We have operated upon five patients. The operation is somewhat more difficult in this than in most other conditions for which it is performed because of the great size of the spleen and the number of adhesions. We believe, however, that it is worth doing.

*Erythroblastosis Fetalis (Erythroblastosis of the Newborn).*—This condition, which has attracted a good deal of recent interest, is really what

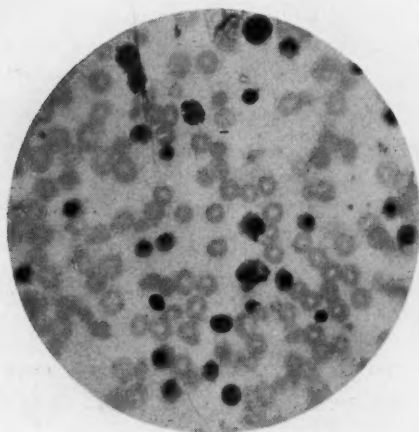


FIG. 1.—Blood smear showing nucleated erythrocytes.



FIG. 2.—Liver—hematopoietic activity— islands of hematopoiesis scattered throughout the parenchyma.

was formerly known as familial icterus gravis neonatorum. It is a macrocytic hemolytic anemia attended by intense bilirubinemia and jaundice, developing either shortly before or just after birth. The familial element is important, as there are other types of severe jaundice occurring during the newborn period, especially those due to sepsis. The blood picture is characterized, in addition to the bilirubinemia, chiefly by a high percentage of nucleated erythrocytes (Fig. 1), most of which are normoblasts. The liver and spleen are enlarged, and on section these and other depots of reticulo-endothelium show many areas of extramedullary hemopoiesis (Fig. 2). The treatment most in vogue has been repeated transfusions, which have saved some of the reported cases.

Nothing is known as to the etiology of this disorder. Inasmuch as a large proportion of the cases terminate fatally within a short time, and as the character of the hemolysis seemed to us strongly suggestive of perverted splenic activity, we have been encouraged to make trial of splenectomy in the only

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two cases in which we have had opportunity. As we were the first to do this, we summarize these cases briefly here.

### CASE REPORTS

CASE I.—A boy, nine days old, of Irish parentage, was admitted to the Children's Hospital, November 26, 1931, because of grave anemia and intense jaundice. The history was of progressive anemia and jaundice beginning during the first day of life. There was a history of several siblings dying with jaundice during the newborn period, and a somewhat vague story of similar happenings in the mother's family.

Physical examination revealed nothing abnormal except the moderately enlarged liver and spleen, pallor and deep jaundice. The blood showed many macrocytes, about 3,000 normoblasts, and a few earlier nucleated forms. Hemoglobin was 3.4 Gm.; red blood cells, 1,080,000; white blood cells, 21,000; differential, normal. The icterus index was 300, and there was marked urobilinuria. A series of transfusions was given, with improvement in the general condition and some lessening of the jaundice. On December 1 the child was taken home because of the intervention of a physician friend of the family. Hemoglobin at that time was 11 Gm. On December 10 he was readmitted with the same picture: hemoglobin three Gm. and very deep jaundice. After a long series of transfusions and some intravenous liver extract with only transient benefit splenectomy was finally performed January 4. Hemoglobin at that time ten Gm.; red blood cells, 3,280,000; icteric index, 300. No transfusions were given after operation. The jaundice disappeared entirely after five days, the icterus index returned to normal within the same time, and the hemoglobin rose and remained between 11 and 12 Gm. Unfortunately the operation wound became infected and the baby died 16 days after the operation of peritonitis. There was no question in our minds that the operation had cured the primary condition.

CASE II.—Seen with Dr. Harry Berman at the Woman's Hospital. A girl baby, born January 14, 1935. Was noticed to be deeply jaundiced within the first 12 hours. She was the second child in the family, the first having died of jaundice when four days old. Physical examination was negative except for marked jaundice and enlarged spleen. She was given 65 cc. of blood 12 hours after birth and splenectomy was performed the following day. Before operation the blood showed: hemoglobin, 90 per cent; red blood cells, 4,250,000; marked macrocytosis and anisocytosis; marked polychromatophilia; numerous nucleated erythrocytes; icterus index, 300. No post-operative transfusions were given. The icterus index remained high for six days, being 260 January 21, but falling to five January 24, by which time the skin had regained its normal color. The hemoglobin reached 99 per cent January 18, remained at that level for several days, then followed the usual course of the blood of the newborn, declining gradually for a few weeks, then rising again. The baby is now a normal child.

The excised spleens in these two cases weighed 96 and 102 Gm., respectively. Both showed the typical pigment deposits and extramedullary hemopoiesis. There was no appearance of phagocytosis of erythrocytes. In both cases lues and sepsis, possible causes of similar conditions, were believed to have been excluded.

From our experience with these two cases, and knowledge of the success of a third splenectomy in the clinic of Doctor Clausen of Rochester, we think that the operation should have further trial in this disease. If it is to be adopted, we think it should be as early as possible, as death sometimes occurs within 24 hours of the appearance of the jaundice, and there seems to be no way of predicting whether in a given case this event may be averted by transfusion.

*Hemorrhagic Disorders.*—Of these there is one, purpura hemorrhagica, in which splenectomy is quite generally conceded to have been nearly as successful in properly selected cases as it is in hemolytic icterus. The proper

selection of cases must be emphasized. Purpura, associated with lack of platelets, occurs in a number of unrelated conditions. Typical essential thrombocytopenic purpura is an idiopathic, often hereditary condition. This is either chronic or recurrent in its nature. There is a very similar condition which is secondary, usually to infection, and which often at least occurs in only a single attack which is followed by complete and permanent disappearance of the symptoms. A third form is that which occurs in several types of disease of the bone marrow in which there is interference with platelet production rather than the destruction of the platelets by splenic hyperactivity which seems to be the underlying fault in the first two types. This latter type is seen particularly in aplastic anemia and in infiltrating disease of the marrow, such as the leukemias.

It is evident that splenectomy cannot be expected to help in the infiltrating diseases or in aplastic anemia and that there would be no good indication for it in secondary purpura in which there is good prospect that the first attack may be the patient's only one. It is, therefore, of course, important that careful differential diagnosis should be made and we believe that it is never wise to operate during a first attack unless it is peculiarly obstinate and long drawn out. We have found by experience that the greater proportion of the patients we see in first attacks of purpura never have a second attack. We have, consequently, out of a very considerable series of cases, found good indication for operation in only six. Of these all, so far as we know, have been permanently relieved. In one of them five supernumerary spleens were removed at the time of operation. This patient has returned once with a few purpuric spots and a slightly low platelet count. The condition was promptly relieved by treatment with snake venom. It is possible, however, that this boy is developing a supernumerary spleen and that later an exploratory operation may be necessary.

We have knowledge of one case, in another clinic, where a similar sequence of events was observed and at a secondary operation a well grown supernumerary spleen was removed. We have had one fatality in a case in which the operation was undertaken only as a last resort with no expectation of success. The patient, an infant one year old, had developed a very severe secondary thrombocytopenic purpura shortly after an attack of measles. In addition to the purpura there was extensive suppurative cervical adenitis. The case was not considered a suitable one for operation, which was performed only when all other methods, including several transfusions, had failed to check the bleeding. The baby was almost moribund at the time of operation, and died within a few hours.

*Splenic Anemia and Splenomegaly with Gastric Hemorrhage.*—Splenic anemia may be said to be the waste basket diagnosis of pediatric hematology. There is a considerable number of conditions in which one may meet with an enlarged spleen and anemia which are quite difficult to classify. Some of them are due to such specific infections as syphilis, malaria, tuberculosis and undulant fever. These, of course, should be carefully ruled out. It is rather

common to consider those in which there is no such obvious cause as belonging in the rather vague classification of Banti's disease, which is hardly thought of nowadays as more than a syndrome. There is, however, one fairly definite type in which there is marked splenomegaly and leukopenia without obvious cause which often at least goes on to the later stages of the Banti syndrome—bleeding from gastric or esophageal varices and ultimate cirrhosis of the liver, in which it is generally believed that favorable results are to be had from early splenectomy. Some observers think that this type should be definitely separated from the miscellaneous group of cases with splenomegaly, due to infection, and without the characteristic leukopenic blood picture. The disease which is spoken of as splenomegaly with gastric hemorrhage differs from this type of splenic anemia chiefly in the fact that the hemorrhages are an early rather than a late symptom in the disease. It is quite possible that both are due to disease of the splenic vessels. Although it has not been possible to demonstrate this in many of the cases at the time of splenectomy it is believed by many pathologists that in the Banti syndrome and possibly in the second syndrome the original trouble does lie in a thrombophlebitis of the splenic veins. Reports of the results of the operation in this syndrome of splenomegaly with early gastric hemorrhage have not been invariably good but a large percentage of the patients have been at least markedly improved and some apparently cured.

We have had six operations for various types of splenomegaly with anemia in only two of which did the condition correspond to the typical splenic anemia with leukopenia. Both of these were definitely benefited by operation and are now doing well. In three others in which the splenomegaly was associated with leukocytosis rather than leukopenia and the condition was probably due to chronic infection, the results of splenectomy have not been especially good. One of the patients has since died; two others have not been particularly benefited. We have had only one case of the type with early gastric hemorrhage. This boy was operated upon one and one-half years ago and has had one very slight bleeding attack since.

With the exception of the cases with erythroblastic anemia we have had no operations for the purpose merely of relieving the patient of the weight of the enlarged spleen of which we have spoken. This indication may occur in leukemia, in Gaucher's disease and in some other types of extreme splenic enlargement, and we think that removal is a perfectly legitimate thing to do provided it is understood that it can give no real relief for the disease process. We have not had occasion to operate for the removal of the spleen as a focus of infection. This might happen in malaria, syphilis, tuberculosis or undulant fever and we have once or twice considered it seriously. We should be definitely inclined to operate under the proper conditions.

#### SUMMARY

The indications for splenectomy, which is having a constantly increasing vogue, are arrived at chiefly empirically, by trial of the operation, as the

fundamental etiologic factors of the conditions in which it may be of service are not well understood.

In general, the reasons for performance of splenectomy fall into four categories:

(1) To put a stop to a perverted, pernicious activity of the spleen, conveniently designated "hypersplenism" (hemolytic icterus, purpura hemorrhagica, erythroblastosis fetalis, sickle-cell anemia).

(2) To check the progress of pathologic changes in the splenohepatic circulatory system (splenic anemia, splenomegaly with early gastric hemorrhage).

(3) To rid the body of the burden of an organ grossly enlarged and rendered useless by disease (erythroblastic anemia, leukemia, Gaucher's disease).

(4) To remove a lurking place for certain types of chronic infection (lues, malaria, undulant fever, tuberculosis).

Results are reported of 29 splenectomies performed upon children. Of these six were for hemolytic icterus; four for sickle-cell anemia; five for erythroblastic anemia; two for erythroblastosis fetalis; six for purpura hemorrhagica; and five for different types of "splenic anemia."

*Hemolytic Icterus.*—This is the condition in which splenectomy has scored its greatest success. All of our patients seem to have recovered completely from the primary disorder, with no signs of recurrence. One has had trouble from postoperative adhesions and duodenal ulcer. We have avoided operating during the hemoclastic crises.

*Sickle-Cell Anemia.*—The rôle of the spleen in the pathogenesis of this disorder is not clear. In our cases the anemia has been little benefited by the operation, but the abdominal and joint crises have been alleviated, and in one case epileptiform attacks ceased after the splenectomy.

*Erythroblastic Anemia.*—Splenectomy in this disease has not appreciably altered the course of the anemia. It is followed by a remarkable, permanent increase in circulating normoblasts. The patients are considerably relieved by freedom from the weight of the greatly enlarged spleen, and may live somewhat longer.

*Erythroblastosis Fetalis.*—In our two cases, and in one of which we have knowledge in another clinic, splenectomy promptly checked the rapidly progressing hemolytic anemia. Considering the gravity of the condition we believe that the operation should be performed as soon as the diagnosis is made.

*Purpura Hemorrhagica.*—Results here are nearly as good as in hemolytic icterus. So far as possible, unless the thrombocytopenia is obstinate, we avoid operating after a single bleeding episode, as the majority of the cases are of the secondary type, and recover spontaneously. Of the six patients operated upon, four recovered completely, one has had a single slight recurrence, and one, operated upon during a very severe bleeding episode, died.



Here, as in hemolytic icterus, we avoid operating during crises, except as a last resort.

*Splenic Anemia.*—Two patients, exhibiting the syndrome with splenomegaly, leukopenia and anemia often called the first stage of Banti's disease, seem to have been cured by splenectomy. Of three, having splenomegaly and anemia without the characteristic leukopenia, apparently secondary to infection, one has died, and two have gone on to the late stages of the Banti syndrome with hemorrhage and cirrhosis.

We have had one case of the condition with splenomegaly and early gastric hemorrhage, which was relieved but not completely cured by operation.

We have had no occasion to operate for chronic leukemia or Gaucher's disease, or to remove a focus of chronic infection, though we believe that the operation may be indicated for any one of these conditions.

We have not formed definite conclusions regarding recent proposals to remove the spleen for hypoplastic or early aplastic anemia.

Whenever a recurrence of trouble appears after an apparently successful splenectomy we think that consideration should be given to the possibility of the development of an accessory spleen.

DISCUSSION.—DR. EDWIN MILLER (Chicago, Ill.).—My experience with splenectomy has been limited to cases of essential thrombocytopenic purpura. Since Werlhoff first described this interesting disease almost 150 years ago, there has been a progressive development in the literature on this subject, and a great part in this development has been taken by Doctor Whipple. There is no question in this disease but that the effect of splenectomy in the majority of cases is as dramatic as anything one sees in surgery.

The case which I have to present is that of a young girl 11 years of age who has been studied at the County Hospital by Doctor Poncher of the Research Department of the University of Illinois, and myself, since 1929, when she presented a typical clinical picture of a very severe case of thrombocytopenic purpura, characterized, as you all know, by spontaneous hemorrhages, by a prolonged bleeding time, normal clotting time (but failure of retraction of the clot), and a very low platelet count. It was obvious, in spite of several blood transfusions with some slight improvement in this girl's condition that splenectomy was definitely indicated.

Almost immediately after splenectomy the condition in this girl improved dramatically. The bleeding time returned very quickly to normal, the clotting time remained normal, and retraction of the clot took place in fairly normal time, the platelet count very rapidly returned to above the normal level, and the tourniquet test became negative. All these signs of improvement have continued since that time, a period of six years ago. We have carefully studied the patient since this time.

We have found since the onset of her menstrual period that she has continued to have no tendency whatever toward any spontaneous bleeding. She has developed normally, gone to school, received all kinds of accidents in play, and there has never been any tendency either in that way or at the time of her menstrual periods for any spontaneous form of hemorrhage, so we feel that the case illustrates the typical good result which we all recognize will follow in a large per cent of those cases of thrombocytopenic purpura which have very accurately been diagnosed before operation.

DR. W. J. MERLE SCOTT (Rochester, N. Y.).—I want to mention only one group of cases that Doctor Penberthy has spoken of because this, as far as I know, is a new indication for splenectomy occurring in literature. This is the group of erythroblastoses of the newborn or the group that is more commonly known in pediatrics as icterus gravis.

Newborn babies, of course, have a physiologic icterus very frequently. The differentiation between physiologic icterus and icterus gravis is as a rule easily made. The icterus, in the first place, appears earlier in icterus gravis than in icterus of the newborn. It appears within 48 hours, usually 24 hours. Of course, it is a much more intensive jaundice, the icteric index being usually between 250 and 300, as in the cases reported here.

We had heard of Doctor Cooley's discussion of one such patient in a pediatric meeting and were encouraged to carry out splenectomy for a typical case of icterus gravis or erythroblastosis fetalis. The mother had already had siblings that died. One brother had died and another had had a very severe icterus which had left him with a condition that frequently follows when they do recover, namely, a profound injury to the brain from the staining with blood pigment that occurs.

We felt we had very little to lose in this child by carrying out splenectomy. It was interesting how, in spite of the very intense jaundice that existed, there was no tendency whatever toward bleeding.

I want to emphasize their recommendation, that in this condition, which has a very high mortality and bad prognosis, it would be well worth while to carry out splenectomy early.

DR. JAMES M. HITZROT (New York, N. Y.).—I would like to report the results of a group of cases of erythroblastic anemia which have been reported before (*ANNALS OF SURGERY*, vol. 88, 1928).

The oldest one, a girl, reported by Stillman (*Am. Jour. Med. Sc.*, vol. 153, 1917) and subsequently by myself, lived for 18 years after a splenectomy, continuing to have the increase in the nucleated reds throughout that period. She went through a number of critical illnesses and finally died of acute pneumonia. Of the other three children from the same family which were reported with this disease, one died of acute mastoid within nine months after the operation. The other boy lived to be 17. He was operated on when he was six. He lived to be 17, with a continued picture of erythroblastic anemia. He grew, went through puberty without any trouble, and died also of an acute condition, probably pneumonia. He was not cured at all although he continued to grow.

The girl in the same family died six years after the splenectomy, presenting the same blood picture, apparently of influenzal pneumonia. I do not know definitely what caused the death of the above two cases as I did not see them but they were reported to me as stated above. The first case is the one that lived the longest and is the oldest in this series so far as Doctor Stillman has been able to find. She was very interesting to us because she was one of the earliest cases and one of the cases that we suspected for the first time as being a curious disease because of the enormous shower of nucleated reds which appeared right after splenectomy.

I would also like to report on another case of an essential purpura previously reported (*ANNALS OF SURGERY*, 1923) who has now lived a little over 12 years. She has gone through pregnancy and went through her menstruation without any difficulties whatsoever, and no unusual bleeding. Her blood picture at this time is reported as perfectly normal.

DR. GEORGE J. HEUER (New York, N. Y.).—I am interested to know if use has been made of a technical procedure in splenectomy which we have employed in several instances. It is well known that if you give adrenalin to a patient with an enlarged spleen, you can demonstrate very easily the considerable shrinkage of the spleen, and if you make blood studies before and after the injection of adrenalin you can demonstrate that the patient with an enlarged spleen may sometimes autotransfuse himself to the extent of 250 cc. of blood.

We have utilized this fact at the operating table, giving the patient an average dose of adrenalin after the abdominal incision had been made and the spleen exposed. We have found it technically, in some cases, much easier to manipulate a shrunken spleen, that has become sort of leathery and tough, than the previously much larger and more friable organ.

One must be sure the adrenalin is active. Recently in a case of enlarged spleen an injection of adrenalin failed to cause shrinkage of the spleen. The adrenalin was tested in the laboratory and found to be inert.

## IDIOPATHIC ULCERATIVE COLITIS

A REVIEW OF 149 CASES

WITH PARTICULAR REFERENCE TO THE VALUE OF, AND INDICATIONS  
FOR SURGICAL TREATMENT

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WE ARE referring to the so called chronic idiopathic ulcerative colitis, excluding, as far as possible, cases of amebic dysentery, tuberculous colitis and bacillary dysentery. It is a diffuse process usually beginning in the rectum (95 per cent of Barger and Mayo's<sup>1</sup> 1,500 cases) and frequently involving the entire colon to the ileocecal valve. Rarely (1.3 per cent of our cases) does it extend into the terminal ileum. It is segmental in rare instances, or may involve only the rectum or a portion of the left colon.

We are not concerned at this time with the etiology of the disease or the relative merits of specific versus non-specific treatment. We, as surgeons, are asked to make important decisions in a group of desperately sick patients. As far as we can tell from our own experience and from the literature, these same decisions must be made whether the disease is infectious or otherwise, and whether specific or non-specific medical treatment is employed.

During the past four years it has been our responsibility to meet any surgical problems that might arise in the cases admitted to the wards at the Massachusetts General Hospital. The number of cases so seen has not been large, but the problems presented have been of the greatest importance, in most instances involving a question of life and death. The relative infrequency with which the decisions have had to be made, the extraordinary variations in the disease, and the resulting difficulty in establishing definite criteria from which to make such decisions have suggested a critical review of the cases at this hospital, with particular reference to those aspects of the disease which pertain to the value of, and indications for, surgical interference.

One hundred forty-nine cases in which a diagnosis of ulcerative colitis seemed definite, according to our present criteria, have been admitted to the wards of the Massachusetts General Hospital during the 20 years prior to January, 1935. During the first decade most of the cases were loosely classed as tuberculosis, many were admitted to the surgical wards and, except in very mild cases, an appendicostomy or cecostomy for purposes of irrigation was advised. During the past ten years the patients have been admitted to the medical wards to be carefully and completely studied in an attempt to exclude tuberculosis, amebiasis, and bacillary dysentery. During this period each case

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not responding to medical treatment has been seen in consultation by a surgeon, and if operation was advised has been transferred to the surgical service. The operation of choice has been an ileostomy with complete external diversion of the fecal stream, except in a few cases where the disease was localized and a more distal procedure could be carried out.

*Symptoms.*—The variations in the symptomatology have resulted in occasional uncertainty as to diagnosis, particularly in the more acute cases. The following points from the histories are of interest.

*Blood.*—Rectal bleeding is an almost constant symptom. It is described most frequently as "streaks of blood" and was noticed by 87 per cent of the patients in this series. Massive hemorrhage—a symptom of serious importance—is fortunately rare, being found in only 5 per cent of our cases. On the other hand, one of our fatal cases had a profuse diarrhea without gross blood, but with large ulcerations visible through the proctoscope and demonstrated throughout the colon at postmortem examination.

*Diarrhea.*—This occurs frequently without blood at the onset, and is present in all cases at some stage of the disease. *Constipation* is not uncommon, particularly prior to the onset of acute symptoms; in fact, in the occasional case obstinate constipation necessitating drastic catharsis has been given as the precipitating cause of the protracted diarrhea for which the patient sought relief. Blood and constipation may be associated just as may blood and diarrhea. In one case constipation, alternating with short periods of diarrhea, was present. The patient finally came to the hospital because of bleeding and failure to have a movement for five days.

*Onset.*—This may be sudden or gradual. One of our patients—a powerful young Harvard athlete—was seized with sudden dizziness and weakness while rowing, followed later by a bloody diarrhea and a temperature of 103°. In other cases, a sudden chill and high fever initiate the attack with an abruptness comparable to that in lobar pneumonia.

*Recurring attacks of fever*, marked prostration, rapid loss of weight and strength, with a natural tendency to remissions and relapses are characteristic of the disease. The frequency of recurrence varies. In one of our cases there were five admissions in a year. The longest period between attacks was 12 years. As in the cases studied by Banks and Borgen,<sup>2</sup> acute respiratory infections and emotional upsets were the most common precipitating causes.

*Complications* are common and at times serious. Peri-anal infections, skin lesions which may be acne-like, or diagnosed as erythema nodosum or erythema multiforme; multiple joint pains and swelling, keratitis, iritis and corneal ulcers have been encountered in this series. Of most significance, however, have been those symptoms referable to lack of vitamins; polyneuritis (in one of our cases resulting in temporary paralysis of lower extremities and inability to walk), skin changes, smooth tongue and tachycardia. Polyposis as it occurred in this series was not a true polyposis but rather a hypertrophy of remaining islands of mucosa following large irregular areas of complete destruction of the mucous membrane and later scar formation.



(Fig. 1). Cancerous degeneration, occurring in 2.5 per cent of 800 cases, reported by Barga<sup>3</sup> has not been found in this series.

*Physical examination* is of importance chiefly because of its negative character except for occasional tenderness along the course of the colon and those conditions secondary to the disease such as varying degrees of emaciation and pallor. The most interesting finding was the presence of a palpable spleen in 3 per cent of the cases.

*Laboratory examinations* are of importance primarily in excluding other



FIG. 1.—Section of the cecum with terminal ileum and of sigmoid from the fatal case dying of a general peritonitis secondary to perforation of the ileum. In this case about 22 cm. of terminal ileum were involved. This specimen shows well the extensive loss of mucous membrane and resulting pseudopolypoidosis.

conditions such as amebiasis, bacillary dysentery, tuberculous colitis, and in estimating the degree of anemia or changes which have taken place in body chemistry.

*Proctoscopy* represents the most important single method of examination. Positive findings were present in all of the cases in this series. The appearance of the mucous membrane varies with the stage or manifestations of the individual case. The mucosa may be covered with a grayish mucopurulent

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film which when gently wiped leaves a dark red granular bleeding surface. The outstanding characteristic is the diffuseness of the process. The red granular edematous mucous membrane, bleeding easily on slight trauma, may be studded with small white dots which represent small miliary abscesses in the mucosa, later breaking down to form the small superficial ulcerations of a later stage. These ulcerations may be small and seen with great difficulty or they may reach one or two centimeters in diameter, coalescing with adjoining ulcers, leaving large areas entirely without mucosa, with islands of edematous dirty red mucous membrane (Fig. 1), giving the appearance of multiple polypi. The valves are involved in the process and later may be scarcely perceptible in the late, rigid, narrow, tube like rectum. These findings are in contrast to the characteristic picture in amebic dysentery where small, superficial, slightly elevated ulcerations are found scattered in an otherwise normal appearing mucosa. From a tuberculous colitis the differential diagnosis by proctoscope alone may be more difficult. According to Martin,<sup>4</sup> diffuse tuberculous colitis with ulcerations visible through the proctoscope is very rare except in a patient bedridden from tuberculosis. The tuberculous process advances from the ileocecal region downwards and through the proctoscope the ulcerations vary from a few millimeters to several centimeters in diameter with irregular outline. The intervening mucosa, slightly reddened, may be differentiated from ulcerative colitis with difficulty by one less experienced. Martin lays great stress on the fact that rarely does one find the diffuse contractions of the bowel and diminution in size of rectal valves in tuberculosis that is frequently seen in ulcerative colitis.

*Roentgenographic examination* by barium enema is next to proctoscopy our most valuable aid. There is early a loss of haustral markings, spasticity, rapid emptying, with the sawtooth serrations due to existing ulcers and later the characteristic contracted, stiff leadpipe appearance, not infrequently with one or more strictures.

The *diagnosis* is suspected in cases of bloody diarrhea with positive proctoscopic and roentgenologic findings, and is accepted when careful hospital study, including serologic and bacteriologic studies exclude tuberculosis, amebiasis, and bacillary dysentery as probable causes. In more recent cases an unsuccessful course of emetine or yatren may be given as additional evidence against an amebic infection. A negative roentgenogram of the chest is accepted as excluding a diffuse ulcerative colitis from tuberculosis. On the other hand, tuberculosis of the lungs may occur in association with a chronic idiopathic ulcerative colitis, as shown by pathologic and bacteriologic study of the diseased colon.

**FATAL CASES.**—Of the 149 cases in our series there have been 27 deaths, a hospital mortality of 18 per cent. Twenty or 74 per cent of the deaths followed some type of operative procedure.

*Causes of Death.*—Of 27 deaths in this series, 18 patients came to necropsy. Of these 18 cases, 13 had some type of operation and five died without operative interference (Table I).

TABLE I

*Causes of Death in 18 Cases Examined Postmortem*

	Number
Without operation	
General peritonitis from perforation of colon . . . . .	3
Widespread sepsis . . . . .	1
Extensive local disease—pneumonia . . . . .	1
After operation	
General peritonitis from perforation of colon . . . . .	3*
General peritonitis from perforation of ileum . . . . .	1†
General peritonitis from opening of appendix stump after ileostomy and appendectomy . . . . .	1
General peritonitis without obvious cause . . . . .	4
Extensive local disease—pneumonia with abscess formation . . . . .	1
Bronchopneumonia . . . . .	1
Abscess of lungs . . . . .	1
Pulmonary edema—fatty degeneration of liver, pulmonary tuberculosis(?), intestinal obstruction . . . . .	1
	—
	18

\* In all three cases perforation occurred before operation.

† Twenty-two cm. distal ileum involved at time of operation; perforation through diseased bowel after operation.

Six of the 12 deaths from peritonitis were due to perforation of the bowel. It is interesting that as far as one could tell from the clinical records there was little evidence to suggest the exact time at which perforation had occurred. It is also of interest that in four of the cases death had occurred without extension of the disease to the ascending colon and cecum.

Records of fatal cases were gone over carefully in the hope of being able to segregate the group in which death was most apt to occur.

Age seems to be important. Ulcerative colitis is a disease of childhood through early middle life, 88 per cent of our cases occurring in patients under 50 years of age. The hospital mortality in this group was 13.7 per cent, as contrasted with 41 per cent in the group 50 years of age and over.

The number of attacks seems to have no great bearing on the seriousness of the individual relapse. In the two cases with longest intervals between attacks—12 and nine years—the second attack of each proved to be of the acute fulminating type with death from perforation within six weeks of the onset of symptoms.

Continued septic fever, rising pulse, abdominal pain, increasing abdominal tenderness or distension, massive hemorrhage, nausea, vomiting or inability to eat, are serious symptoms and were present singly or in combination in the fatal cases.

**TREATMENT.—Medical Treatment.**—Whereas formerly patients were admitted to and treated on either medical or surgical wards, all patients are now treated on the medical wards. The basic principles of treatment are: (1) rest, (2) high vitamin, high caloric, low residue diet; (3) eradication of focal

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infection; (4) adjustment of social and psychiatric problems; (5) multiple transfusions. These form an integral part of the management of all the seriously ill patients whether or not operation becomes necessary. We have seen no ill effects from properly given transfusions as feared by Emery and Wasika.<sup>5</sup> The largest number given to one patient during a single entry was seven. This patient survived an ileostomy and later a total colectomy; (6) irrigations; a variety of solutions have been used for irrigating the diseased colon, either through an appendicostomy or per rectum. Dilute silver nitrate, dilute solutions of potassium permanganate, acriflavin and Dakin's solution have all been in favor over varying periods of time. No one has any real claim to superiority over any other. We are unable to convince ourselves that irrigations of any type are of value and believe they may be harmful in the more acute cases. The one local procedure which has been used over a period of years is the gentle installation of warm starch solution into the rectum. This seems to give enough temporary relief to the badly irritated rectum to justify its use; (7) autogenous vaccines and ulcerative colitis anti-streptococcus serum have been used on a few patients but are not an integral part of the treatment; (8) emetine hydrochloride and yatren may be used on occasion as additional evidence for or against an amebic infection.

**SURGICAL TREATMENT.**—The surgical procedures used in an attempt to help control the disease are noted in Table II.

TABLE II  
*Operations Employed in 140 Cases of Ulcerative Colitis*

Operation	Number	Deaths	Mortality Per Cent
Appendicostomy.....	4	2	50
Cecostomy.....	2	0	0
Colostomy.....	4	2	50
Resection and anastomosis.....	1	0	0
Ileostomy.....	54	15	35
Colectomy:			
subtotal..... 8			
total ..... 2	10	1	10
Miscellaneous.....	22	2	9

There is nothing in a study of the above cases to alter our belief that the only operation which is indicated in ulcerative colitis is one which will give complete rest to the affected bowel by external diversion of the fecal stream proximal to the disease; and with few exceptions this means ileostomy. Failing this the only other recourse is extirpation of the colon.

**Incidence of and Immediate Results after Ileostomy.**—Although 54 or 36 per cent of the 149 patients have had ileostomies, the incidence of 41 per cent which has occurred in the past ten years probably more nearly represents the proportion of hospital patients who ultimately are operated upon. Ileostomy is not a curative procedure but the striking drop in temperature and pulse (Chart I) and the general improvement of the patient suggest the value

of complete rest to the badly diseased bowel. Unfortunately, the improvement is not always so striking as suggested in the accompanying chart. A rapid fall of temperature by crisis or lysis is sufficiently common, however, to leave little doubt in our minds as to the value of an ileostomy as a life-saving procedure.

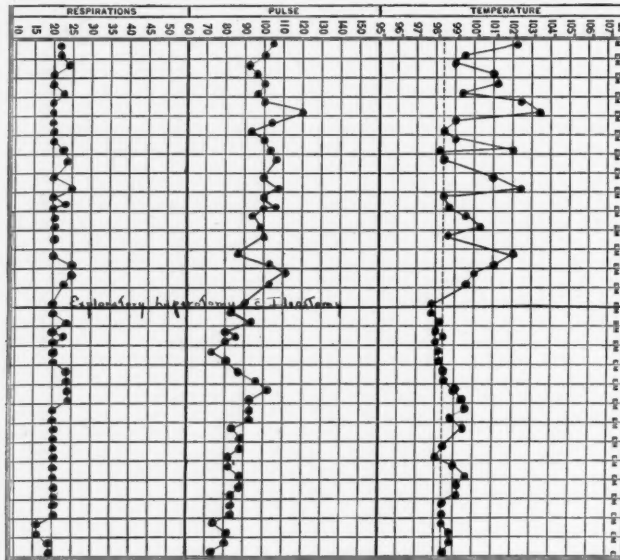


CHART I.—Shows striking drop in temperature immediately following ileostomy. This patient remained well for five years; later requiring subtotal colectomy for repeated hemorrhages.

We look upon ileostomy as a permanent condition. Rarely if ever under our present regimen will a badly diseased colon become free from disease after ileostomy. Should healing take place, multiple strictures and contractions will result making subsequent function impossible. Rather do we look upon ileostomy as the first stage of a removal of the diseased bowel in what will eventually probably be a high proportion of cases.

*Mortality Rate and Causes of Death after Ileostomy.*—Fifteen or 35 per cent of the 54 patients died. Decisions were made and operations done by 13 different surgeons. The benefits to the patient of the concentration of the more unusual and difficult problems to a small group of men is shown in Table III.

TABLE III

*Mortality Rates Following Ileostomy According to Number of Operators*

	No. operations	Deaths	Mortality per cent
Group I (2 operators).....	20	3	15
Group II (11 operators).....	34	12	35

A study of the fatal cases after operation fails to show specific reasons for the variation in mortality between the two groups.



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TABLE IV

## *Causes of Death after Ileostomy*

Group I (2 operators)	General peritonitis from	
	perforation of colon (autopsy).....	I
	perforation of diseased ileum (autopsy).....	I
	Progression of disease (autopsy).....	I
Group II (11 operators)	General peritonitis from	
	open appendix stump (autopsy).....	I
	no obvious cause (autopsy).....	3
	Bronchopneumonia (autopsy).....	I
	Abscess of lungs (autopsy).....	I
	Acute fulminating attack (no autopsy).....	I
	Cause undetermined (no autopsy).....	4
	Massive hemorrhage (no autopsy).....	I

From the records one finds that in Group I the patient dying of "progressive disease" had been erroneously diagnosed as cancer and an exploration done. In Group II all except two patients had an exploration under general or spinal anesthesia and in five cases the appendix was removed at the time the ileostomy was done. The patient dying of general peritonitis secondary to an open appendix stump seems to us to be of sufficient significance to report in detail.

## CASE REPORT

A boy of 16 was discharged from the medical wards July 22, 1933, 29 days after admission, for what was taken to be a mild ulcerative colitis. Two days after returning home he suddenly felt sick, vomited, had abdominal pain and movements every two hours. He lost ten pounds in five days. He was acutely ill on admission, vomiting and having almost constant bloody movements. With no improvement in 48 hours an ileostomy was advised and done under novocaine infiltration. An edematous fibrin covered appendix presented in the wound, the cecum was red, edematous, and there was a small amount of clear fluid. The operator was fearful of leaving the appendix and removed it, burying the stump with a fine catgut suture. An ileostomy was done. The immediate response to operation was fairly satisfactory except that he had more abdominal discomfort than usual. Six days after operation there was a marked increase in pain, with vomiting, elevation of temperature and death three days later. At autopsy there was a general peritonitis, the stump of the appendix being wide open.

From our own experience and from a study of fatal cases we believe that, except for those patients done for mechanical reasons, the following conclusions seem justified:

- (1) Novocaine locally is the anesthetic of choice.
- (2) Exploration is dangerous and contributes little if anything to the subsequent care of the patient.
- (3) A colon so diseased that ileostomy is indicated is too diseased to make appendectomy safe.

*Indications for Ileostomy.—Technical Considerations.*—Bargen, Brown and Rankin<sup>6</sup> have given the following mechanical indications for ileostomy:

- (1) Polyposis with or without carcinomatous degeneration.
- (2) Strictures.
- (3) Incontinent anus.

In addition to these indications we believe that ileostomy has a definite place: (1) as a life-saving procedure, and (2) as a means *per se* or preliminary to subtotal colectomy, of changing a person from a condition of chronic invalidism to one of comparative physical well being and economic usefulness. We do not underestimate the inconvenience of an ileostomy, but we know no better criteria of the seriousness and discomforts of the disease than acceptance of ileostomy by the patient who has known these and feels compensated by the relief which ileostomy has given.

It is easy to say that an indication for ileostomy is the fact that adequate medical treatment has failed. The irregular course of the disease, its tendency to remissions, the insidious manner in which perforation may occur on the one hand, and the desire to do everything possible to avoid an ileostomy on the other, all tend to make the final decision one of the most difficult in medicine or surgery. Of one thing we are certain: absence of definite indications that medical treatment has failed is frequently responsible for "waiting another 24 hours for signs of improvement," possibly finding some indication that such has occurred, then delaying another day only to realize that the time has passed when ileostomy would be of avail.

While certain symptoms and signs are of more significance than others, it is impossible to give any definite criteria which will permit one to say that medical treatment has failed and ileostomy should be done. Those we believe to be of greatest importance in reaching this decision are:

- (1) Massive hemorrhage which usually denotes large and deep ulcerations, and in itself may be an indication for early operation.
- (2) Persistent fever especially if accompanied by a rising pulse.
- (3) Nausea, vomiting or inability to eat, particularly if associated with a serum protein below 5.5 per cent.
- (4) Abdominal pain, increasing distention or tenderness along the course of the colon.
- (5) Continued bloody diarrhea with secondary anemia when the patient's general condition, red blood count and hemoglobin are maintained, but not definitely improved by four transfusions of 500 or 600 cc. of blood at four to seven day intervals.

Any of the above symptoms in a patient over 50 years of age is more serious than in younger patients, and earlier operation is indicated.

In making final decision one must recognize that ileostomy is not curative, and while striking improvement may result from rest of the diseased colon, the patient must still have sufficient reserve strength to withstand the operative procedure and immediate postoperative discomforts.

*Technical Considerations.*—Rankin<sup>6</sup> prefers an end ileostomy and describes an excellent technic. It has been our experience that in those cases where operation is done as a life-saving procedure the condition of the patient and the limitations of novocaine anesthesia will not permit closure of the right

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gutter. The simplest procedure is a loop ileostomy, drawing a loop of ileum eight to ten inches from the ileocecal valve through a small right rectus or McBurney incision; a strip of fascia and skin are sutured underneath the bowel, as described by Jones<sup>7</sup> for a colostomy. We have also used the end ileostomy dividing the ileum about eight inches above the ileocecal valve, inverting the distal end and dropping it back into the abdomen without obliterating the space between the bowel and lateral abdominal wall. We are not entirely satisfied with the results. There is a tendency, particularly of the loop ileostomy, to prolapse requiring a secondary operation in 20 per cent of our cases. If, on the other hand, the wound is closed too tightly around the bowel, obstructive symptoms will develop which, though not marked, may be of serious consequence to a patient already critically ill and badly in need of food.

COLECTOMY.—Of the 29 patients surviving ileostomy in the past ten years, ten have had a total or subtotal colectomy at this hospital and two elsewhere. There has been one death in our series, a patient who after a short period of improvement following ileostomy had a recurrence of symptoms, temperature and bloody discharge. A late and unsuccessful attempt was made to remove the colon in the hope of saving her life.

INDICATIONS.—The indications for colectomy are more definite than those for ileostomy and are

- (1) Polyposis with or without carcinomatous degeneration.
- (2) Recurring attacks of bleeding, temperature and malaise after ileostomy, frequently associated with multiple skin infections and joint symptoms.
- (3) Continued anemia and failure to gain in strength and weight, without other demonstrable cause.

If possible, the interval between ileostomy and colectomy should be at least four months to permit the small bowel to assume some of the functions of the colon and to get the patient into better general condition (Table V).

TABLE V  
*Indications for Colectomy and Interval Between Ileostomy and Colectomy*

Interval	Indication	Result
49 mos.	Attacks of bleeding.	Relieved
24 mos.	Rectal bleeding. Painful joints.	Relieved
38 mos.	Protracted relapse with fever. Bleeding. Failure to gain after 4 transfusions.	Relieved
19 mos.	Continued rectal movements. Multiple skin infections. Corneal ulcer. Toxic arthritis. Acute iritis.	Relieved

TABLE V—*Continued*

Interval	Indication	Result
8 mos.	Continued symptoms. Blood. Lack of strength. Frequent vomiting.	Relieved
8 mos.	Continued loss of blood. Secondary anemia.	Relieved
5 mos.	Frequent bloody rectal movements. Toxic arthritis (knees). Entered hospital with fever. Strength not regained.	Relieved
8 mos.	Attacks of bleeding. Strength not regained. No weight gain. Continued secondary anemia.	Relieved
9 mos.	Continued bleeding with fever. Deficiency symptoms.	Relieved
2 mos.	Progressive failure. Marked anemia. Low serum protein.	Died

*Technical Considerations.*—The technical details of total and subtotal colectomy have been well described by Rankin,<sup>8</sup> and Coffey.<sup>9</sup> Total colectomy is a three stage procedure: (1) ileostomy; (2) removal of colon to the lower sigmoid; (3) removal of the rectum and remaining sigmoid. To date the last stage has been necessary in only two of our patients.

Ether anesthesia is used. A long left paramedian incision is made and the colon removed either from right to left (R. H. M.) or from left to right (L. S. M.). We believe strongly in preservation of the omentum, suturing its under surface to the transverse mesocolon and to the posterior peritoneum in the splenic and hepatic regions where the posterior peritoneum is less well defined and the retroperitoneal surfaces more difficult to cover. The entire bed of the colon is carefully covered either with omentum or peritoneum (Fig. 2). If not previously done the space between the ileostomy and right abdominal wall is obliterated.

The upper end of the lower segment may in an occasional case be turned in and dropped back into the pelvis. In most cases, however, we prefer bringing it out of the lower end of the wound not only because of the saving of time but also because we believe it to be safer. In one of our earlier cases the rectal stump and failure to preserve the omentum were responsible for a fatal acute small bowel obstruction occurring three weeks after the patient left the hospital.

If continued rectal bleeding or peri-anal infection makes it desirable to remove the remaining segment of bowel, this is done by a combined abdomino-

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perineal operation or, if the stump of rectum has been turned in and dropped into the pelvis, by excision from below.

### SUMMARY

One hundred forty-nine cases of idiopathic ulcerative colitis admitted to the Massachusetts General Hospital during the past 20 years have been reviewed.



FIG. 2.—The sigmoid has been divided, the distal end with the clamp in place and covered with gauze is brought out through the lower end of the wound. The mesentery has been divided close to the bowel as far as midtransverse colon, the omentum being carefully separated from colon. The posterior peritoneum has been closed as the operator proceeds, the large uncovered area at the splenic flexure being covered with omentum which is then sutured to the transverse mesocolon. If the operator prefers the operation may begin by division of the terminal ileum and proceed from right to left.

The important general aspects of the disease have been considered.

The indications for, the principles of technic, and the immediate results after ileostomy, subtotal and total colectomy are discussed.



## CONCLUSIONS

- (1) Surgery in carefully selected cases has an important place in the management of the intractable and more serious cases of idiopathic ulcerative colitis.
- (2) Ileostomy is the operation of choice. Preceded and followed by blood transfusions and other indicated measures it is frequently a life-saving procedure.
- (3) It was ultimately performed on 40 per cent of patients admitted to the wards of the Massachusetts General Hospital.
- (4) Approximately 40 per cent of patients surviving ileostomy will later require removal of the diseased colon.
- (5) The results after subtotal colectomy are excellent.

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DISCUSSION.—DR. RICHARD H. MILLER (Boston, Mass.).—I shall consider briefly certain technical points which we feel are of interest and importance.

The operation of ileostomy, which would at first thought seem to be simple, is, as a matter of fact, fraught with danger. The ileostomy should be made within the last 12 inches of the small intestine and the proximal loop should be lower than the distal loop. The opening in the muscle should not be larger than enough to accommodate two fingers. If it is larger than that, there is great tendency to herniation of the bowel, and if it is smaller, there will often develop obstruction at the point where the bowel emerges through the abdominal wall.

It is not uncommon to see intestinal obstruction from the simplest sort of twist or kink in the bowel. It is not definitely represented here, but we have seen instances of the typical picture of mechanical obstruction where there was nothing save the least bit of kinking where the ileum traverses the anterior abdominal wall.

At the time of doing the ileostomy, exploration should never be performed, because there is altogether too much danger of setting up a general peritonitis. The exploration and palpation of the large intestine has been compared to the situation existing in a canvas tent during a rain storm. If one stands inside the tent, the roof will be perfectly dry on the inside until one draws a finger along it and then drops of water will appear and drip down. That may occur when one rubs one's hand over the diseased colon.

We have seen instances in which papillomata develop on the exteriorized mucous membrane as a result of the constant irritation of the ileostomy bag, and have been obliged to remove them surgically.

I want to emphasize again what Doctor McKittrick said about the necessity of preservation of the great omentum in cases in which the colon is removed. We believe very strongly that its preservation results in greater protection against later intestinal obstruction. At first thought it might seem a bit difficult, but when you come to do it you will find that the transverse colon can be dissected free without the slightest trouble.

A last word about the rectum. Doctor McKittrick has usually saved the rectum and colon, whereas I have taken it out farther down and frequently turned in the stump. To my surprise there have been occasional instances where the disease has peristed in the rectum in spite of the fact that the patient's general condition has greatly improved. Again, in another case just recently, it has been necessary to remove the remaining rectum because of persistent bleeding. The removal of the existing stump is not difficult if one will simply open the rectum, insert the forefinger into its lumen, and so determine definitely where the upper end of the stump is, by doing which one avoids the risk of possibly opening the peritoneal cavity.

In all these cases which we have followed of recent years, we have seen definite improvement and we believe that ulcerative colitis is a disease in which surgery plays a very important rôle. There are a certain number of cases demanding ileostomy, and of those who are improved by ileostomy, a certain percentage, about 40, require colectomy, and colectomy is, comparatively speaking, a safe procedure.

We have a number of patients going about their business today, well satisfied with their artificial anus, able to handle it cleanly and without particular difficulty, and those are ones who, without some type of surgical intervention, such as this, would certainly have died of their disease a long time ago.

DR. VERNON C. DAVID (Chicago, Ill.).—The informative review of the surgical side of ulcerative colitis just presented by Doctors Miller and McKittrick emphasizes the seriousness of the disease and the relatively frequent necessity of the performance of ileostomy and less frequently, colectomy. In the performance of ileostomy, it has been our custom to omit exploration of the abdomen as it has frequently been found that free fluid and fibrinous exudate are present in the peritoneal cavity due to its involvement by extension from the inflamed colon.

To supplement the cases reviewed by the essayists I should like to comment on some data obtained from the care of 50 cases seen in private practice during the past ten years. The ages of the patients varied from five to 50 years and there were 31 females and 19 males in the group. The cases could be relatively easily divided into two groups of mild and severe examples of the disease. Both groups were composed, in the main, of patients who had suffered with the disease from one to 16 years. In the group of mild cases, the general health of the patients was little affected; their color and weight was practically normal; there were only a few acute exacerbations of the disease, and the ulceration was usually confined to the rectum, sigmoid and descending colon. In most of the mild cases the roentgenologic examination of the colon showed but slight narrowing of the affected bowel and lack of haustration, but no foreshortening or stricture of the colon. On the other hand the severe cases exhibited fever, loss of weight, anemia, almost constant diarrhea, involvement of practically the whole colon by the disease and

a distinctly downward course. In this group two patients had an acute fulminating course with death within six weeks in spite of ileostomy.

The bacteriology of most of the cases was carefully considered, many not only having routine examinations of the stools but aerobic and anaerobic cultures were made from material taken from the rectal ulcers. The results of these examinations were anything but uniform. *B. coli*, streptococci (often hemolytic) of various types, dysentery bacilli, *C. welchii*, and many other organisms were found. Usually the most carefully studied cases showed a mixed flora.

There were 28 mild cases treated by neutral acriflavine enemata and high vitamin diet. Most of these patients were improved and four patients were apparently cured, although it is our belief that the cure is relative, due to the well known tendency to relapse. Surgery was not resorted to in any of these patients; there were few complications and no deaths.

There were 22 severe cases which had lasted from a few weeks to 16 years. Complications occurring in this group were:

(1) Joint swelling.....	2
(2) Leg ulcers.....	1
(3) Marked stricture of the bowel.....	5
(4) Perirectal abscess.....	5
(5) Rectovaginal fistulae.....	4
(6) Polyps of the colon.....	1
(7) Ulceration of labia and clitoris.....	1
(8) Infection of abdominal wall from involvement of the ileum.....	1
(9) Subacute peritonitis of various grades.....	5

These patients had the following major surgical procedures carried out:

Ileostomy.....	7 with 2 deaths
	3 of these patients were radically improved; 2 moderately improved.

We advised ileostomy in seven other patients but it was refused.

Three of these patients subsequently died.

Colectomy—One patient with marked stricture of the colon following ileostomy, marked improvement.

Appendicostomy—None in our hands but one case ileostomized had had a previous appendectomy.

<b>Results:</b> Dead.....	6
Improved with ileostomy.....	5
Treatment with diet, acriflavine, etc., moderately improved.....	5
Condition the same.....	5

DR. CHARLES C. LUND (Boston, Mass.).—I am not able to present a study of as large a series of cases as either Doctor McKittrick or Doctor David have reported, but I have studied intensively three of these acute cases in my own practice, and one that I have recently labored over was a patient of my father's.

All these were very severe. They all had ileostomies. Two had complete colectomies and removal of the rectum. I have a distinct impression that in the severe cases fairly early ileostomy is definitely indicated, and at not too late a date after that, unless they make a more remarkable improvement than usual, a total colectomy is indicated.

The case that I have just finished began 15 years ago, at which time my father did an ileostomy. Ten years ago he removed the colon, and she

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returned to pretty nearly normal life. Six months ago she began to go downhill again with discharge from the remaining sigmoid and rectum. On removal of the rectum a quite remarkable thing happened. Her ileostomy was for some reason or other a little more contracted than usual and had a very small opening. This never bothered her because her ileostomy discharge was always completely liquid.

Five days after removing the segment of rectum which, of course, was quite distant from the ileostomy, the ileostomy contents thickened so much that on the eighth day I had to enlarge the ileostomy. There is apparently some reflex acting that is extraordinarily interesting and will warrant a lot of further study.

DR. DANIEL FISKE JONES (Boston, Mass.).—Wished that reporters might be a little more accurate in regard to what they were talking about. It is quite confusing when one man says he cures 90 per cent of these cases by vaccines or serums, when the rest of us cannot cure even 1 per cent nor  $\frac{1}{2}$  of 1 per cent. We would like anybody to show a series of cases of chronic ulcerative colitis of any duration at all, that you can call chronic, that have been cured by vaccines or by anything else. There is a very definite acute ulcerative colitis which is a very serious disease and which will kill a large number of patients, whether you do an ileostomy or not. Occasionally, I think that an ileostomy will save a patient.

The case Doctor Lund spoke of, whom I saw with him in consultation, was an acute ulcerative colitis following delivery. She had very deep ulcerations entirely through the posterior wall of the rectum as well as through the vaginal wall, and perirectal abscesses. An ileostomy was done and the sphincter cut, and the colon irrigated. She recovered. One hundred per cent do not get well, and never will, but if you let them alone they will certainly die, I believe, in a little higher percentage than if you do an ileostomy.

You will be very sorry for yourself if you do an ileostomy on a large number of these cases. Doctor McKittrick said 35 per cent died following ileostomy. Let us find out what percentage die if you let them alone. I am not referring to chronic ulcerative colitis, but to acute cases.

Few men seem to state definitely whether they are talking about acute, subacute, or a chronic ulcerative colitis which can be definitely diagnosed by the history and proctoscopic examination. Let us be reasonable about this matter and try to talk about the same condition instead of going on as we are at the present time.

There is a group of men who do not believe in ileostomy. As an example, a boy nine years old had chronic ulcerative colitis, was given vaccines for a long period and by men who know how to use them. He was sent to Colorado. He went down to 50 pounds there, never went to school, and could do nothing other boys of his age did. He was prevented from having an ileostomy for ten years. That boy was operated upon recently and within two months he weighed 25 pounds more than he had ever weighed before in his life. He is going to school now and drives an automobile. I am sure you gentlemen would be a fair if a case like this were put to you and would admit that ileostomy was an excellent procedure.

Let me impress upon you that ileostomy does not cure the disease. Ileostomy "cures" your patient. A case in point is a patient who, after ileostomy, gained markedly in weight and was quite well for four and one-half years. She was tired of the ileostomy and wanted something done. I therefore sent her to those who cure 90 per cent of their cases. I was told that this was a healed colitis. She was sent back to me to close the ileostomy

as she was cured. Three months after her return she nearly died of hemorrhage, and in another three months she had another hemorrhage, and in another three months I took out her colon. It may have been the vaccine or the serum that caused the ulceration in the colon, but when I took it out there was not a piece of mucous membrane as large as the nail of your little finger in the colon. If anybody can prove to me that vaccines will cure such cases as that, I should be glad to have it shown.

I think it is too bad to go on saying that ileostomy should not be done. I am sure it is keeping a lot of patients in bed, and it is not only keeping the patients in bed, but in children it is keeping the mother from doing anything but attending the child. I think it is much better to have a "cured patient" even if the disease is not cured.

There is a perfectly definite type of chronic ulcerative colitis which is progressive and has, so far as I know, never been cured. You may be able to cure early mild cases. I do not know what the difference is, but I know that if you get a real case of chronic ulcerative colitis which you are able to call chronic, that has gone on for a year or two, very few if any cases in this country have been really cured. I am quite sure that if we could only get to talking the same language about this disease we might get somewhere, but with the nomenclature as varied as it is at the present time and with so little said about the proctoscopic and roentgenologic findings, we certainly shall never get anywhere.

DR. HOWARD L. BEYE (Iowa City, Iowa).—Our experience at the University Hospital consists of 39 cases which have been operated upon. Fifty-one operations have been performed. Our results in respect to ileostomy have been very discouraging. There have been 12 cases. Of these there was an immediate or hospital operative mortality of 50 per cent (six cases). Of the six cases that survived, two of them subsequently died of the disease and two of them were so dissatisfied and discouraged with the ileostomy that they sought elsewhere a reestablishment of the continuity of the bowel and died following that.

One of our patients did fairly well. The bowel seemed to be improving and because the ileostomy was so discouraging to this patient, a young girl, I reestablished continuity. She survived, but did not do well. I subsequently did a compromise colostomy and she is getting along fairly well. She will come subsequently to partial colectomy.

We have had only one case, therefore, in which there has been an adequately functioning ileostomy who led a relatively normal life with this handicap. He has subsequently had a total colectomy. So, as a compromise to this very discouraging condition which develops from ileostomy, we have gone back to appendicostomy and cecostomy to give it a trial. We have been doing this now about four years and have 21 cases that have been treated in this way, realizing that it is purely a compromise.

We have found that frequently a very striking degree of improvement will follow this. The improvement, however, takes place in its completeness in the first year. Beyond that time the patient will not improve further, in our experience. In some cases the improvement has been very striking. We introduce a very small tube, about an eighth or ten French catheter in the appendicostomy opening. Irrigation is carried out once or twice each 24 hours, using 1,000 cc. of tap water. Our results have been as follows:

There have been five deaths, two of which were in the hospital and three subsequently from the disease (24 per cent). There has been one complete cure by the strictest standard that one can erect. This has been a clinical cure. There has been no cure as far as the condition of the bowel is con-



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cerned, as shown by barium enema. This patient, an adult, had 15 or 20 stools per day, lost 85 pounds in weight. He is now doing heavy farm work, has one stool a day, and is perfectly strong. This has been three years ago. His tube has been removed and the appendicostomy opening which failed to heal has been closed by operation. We have had another case not quite so marked, but the improvement has been very striking, a gain of 20 pounds in weight, has two stools a day, does heavy farm work, but still wears his tube. We have had eight cases showing slight to considerable improvement. One case did not improve at all. I think he was made worse. Of the entire group, there have been five patients who have subsequently had either colostomy or colectomy.

We have learned, when we utilize this method of treating these cases that we must anticipate, except in the very exceptional case in which we might get a clinical cure (we do not expect that), that the tube must be worn permanently. If the patient pulls the tube out, or it becomes dislodged during the first year, or if the patient ceases to carry out irrigation treatment, there will be a return to the former condition.

As a compromise between ileostomy and appendicostomy, we have carried out colostomy in 11 cases. This is relatively simple and easy to determine upon if one is dealing with a regional colitis involving, say, the left half of the bowel or sigmoid, as it sometimes will. However, in four cases I have compromised to the extent that I have performed a colostomy through the midtransverse colon in bowel that was diseased, but relatively less diseased than on the left. I have made this compromise because of our discouraging experience with ileostomy. One patient died and three patients have gotten along very well, much better in fact as far as their social life is concerned than those with an ileostomy.

In our small group we have had one total colectomy, five partial, and three others in our series are candidates because of the continued symptoms which they have following colostomy or appendicostomy. There have been no fatalities in our series of colectomies.

DR. LELAND S. MCKITTRICK (Boston, Mass.).—In reply to Doctor Beye, we went over our records quite carefully relative to the appendicostomies which were quite popular in the early part of the series, and found nothing which could convince us that appendicostomy had any effect, whatsoever, on the disease. We believe quite firmly that medical treatment as now carried out at the Massachusetts General Hospital accomplishes as much as appendicostomy accomplished in the past, and are convinced that if operation becomes necessary external diversion of the fecal stream is essential.

We should dislike very much to leave the impression that we underestimate the inconvenience of an ileostomy or that we overestimate its value. It may be that our New England patients are somewhat euphoric, and are less disturbed by the ileostomy than those elsewhere. But when you have a young man tell you that he swam two miles last summer, feels fine and is happy with his ileostomy, it cannot be as bad as some would have us believe.

However, the patient who has an ileostomy must know what the disease means and have been very uncomfortable. It must either have saved his life or restored him from a state of invalidism to one of relatively good health. Moreover the patient must want to live.

We believe ileostomy to be permanent. It should be done under novocaine without exploration and without removal of the appendix. The mortality should not exceed 15 to 20 per cent, and that approximately 50 per cent of the survivals should be able to carry on a reasonable life, and that the other 50 per cent will eventually come to colectomy.

## REGIONAL ILEITIS

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OUR attention was first directed to this lesion as a clinical entity in January, 1932. A young man, aged 27, was admitted complaining of colicky abdominal pain, diarrhea and loss of weight. He had had an appendectomy 12 years before. An abdominal mass below the umbilicus was palpable. At operation the mass was found to be composed of loops of terminal ileum, swollen, engorged and agglutinated. The mesentery was tremendously thickened and contracted. Tuberculosis or possibly malignant lymphoma seemed the most probable diagnosis. In mobilizing the mass for exploration, uncontrollable hemorrhage was encountered, requiring resection and anastomosis between the ileum and ascending colon. Pathologically the process proved to be a chronic inflammatory ulcerative enteritis involving the terminal ileum without evidence of tuberculosis or malignancy. The cecum was entirely free of disease.

Shortly afterward, at the meeting of the American Medical Association, Crohn and his associates described their cases of regional ileitis and separated them as a subgroup from the benign granulomata. It was evident that the above case fitted absolutely into their group. Our attention having been directed to the symptom complex accompanying the underlying pathologic process, we have since made a correct preoperative diagnosis on several occasions. Eleven definitely proved cases are available for analysis, including one case of ileocecal resection performed in 1931 which has since been reviewed and recognized as belonging to this group. The other cases have been operated upon during the past three and one-half years. Eight of the 11 patients were of Jewish extraction. Whether or not there is a racial predisposition to this disease I cannot say, but at the Beth Israel Hospital we have encountered a greater number than in other larger hospitals in this community.

Our statistics confirm those previously published. It is a disease preeminently of young adults. The youngest was 14 years, the oldest 56 years and seven occurred in the twenties. In this series, males were more often affected than females. In five cases there had been an appendectomy from 18 months to 12 years previously. One of these had been operated upon at another hospital two years before and the abdomen drained, though the pathologist reported chronic appendicitis. Two to three months later a fecal fistula developed in the scar. In view of the absence of acute inflammation in the appendix it seems probable that some other acute inflammatory process was present at the primary operation for which drainage was indicated, though no other procedure was undertaken. In another case the symp-

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toms were of 21 months' duration. Appendectomy was performed three months after onset without relief of symptoms. At a subsequent operation a chronic abscess cavity between coils of ileum and inflammatory adhesions between the ileum and sigmoid, apparently the forerunner of a fistula, was encountered. Such histories and operative findings strongly suggest that the regional ileitis was present, but its significance not recognized, at the time of the primary appendectomy.

TABLE I

	Cases
Age*	
Under 20 years.....	3
20-30 years.....	7
Over 30 years.....	1
	— 11
Sex	
Male.....	8
Female.....	3
	— 11
Appendectomy	
1½-12 years previously.....	5

\* Youngest, 14 years (2 cases); oldest, 56 years.

The classic symptoms frequently resemble those of mild ulcerative colitis—namely, fever, diarrhea, and loss of weight. Eventually partial obstruction of the small intestine may occur. There is usually a palpable mass in the right lower quadrant. The maximum intensity of the process is in the terminal ileum and involves the ileocecal valve but not the cecum. The lesion becomes less pronounced as it progresses upward along the small bowel and usually involves not more than one to three feet of lower ileum. There is a marked tendency to the formation of sinuses, leading chiefly to adjacent coils of ileum, the sigmoid or cecum, or externally through the abdominal wall at the site of a previous laparotomy scar. Abscess formation between coils of ileum or the leaves of the mesentery is common from slow perforation.

Crohn grouped the cases into four clinical types, representing progressive stages in the disease.

Group 1.—This group shows signs of acute intra-abdominal inflammation, indistinguishable preoperatively from acute appendicitis. There are pain and tenderness in the right lower quadrant, cramps, fever and leukocytosis. A mass may be palpable. At operation, the terminal ileum is reddened, greatly thickened and bleeds readily, and its mesentery is edematous, containing enlarged hyperplastic lymph nodes. The appendix may be reddened and involved by contiguity but it shows no mucosal inflammation.

Group 2.—The second stage presents symptom suggestive of ulcerative colitis. There is colicky abdominal pain and looseness of the bowels, at

times with blood and mucus. There is slight fever, malaise, marked loss of weight, and anemia, often severe, develops.

Group 3.—The stenotic stage follows the ulcerative phase. Due to the extreme thickening of the bowel wall the lumen of the bowel becomes constricted and may be partially obliterated by the healing of the mucosal ulcerations. Usually the narrowing is most evident near the ileocecal valve, while above, in the more recently involved portion of the bowel, the earlier ulcerative phase predominates. The symptoms are those of partial obstruction of the small intestine. In this stage a mass is usually felt.



PRINT 1.—Examination three hours after ingestion of barium shows slightly dilated loops of small bowel in the pelvis. The terminal ileum shows an irregular narrowing, most marked just proximal to the ileocecal valve. There is an ovoid area of increased radiance, about 2 cm. proximal to the valve, which is suggestive of a polyp. There is also a very fine line of barium just proximal to the polyp, directed toward the cecum, which may be due to a fistula. There is also a slight irregularity of the medial wall of the lower pole of the cecum.

PRINT 2.—There is no evidence of delay, obstruction or gross irregularity of the colon. The ileocecal valve is patent. The terminal 8 cm. of the ileum are irregularly constricted. Just proximal to the ileocecal valve there is a thin column of barium directed upward, about 1½ cm. long, which is probably due to a fistulous tract.

Group 4.—The stage of fistula formation. This is a late manifestation of the disease and is the result of slow perforation of the ulcers. Frequently multiple fistulae are formed. They may open externally through the abdominal wall or they may be internal and can at times be demonstrated by roentgenologic examination of the gastro-intestinal tract. In contradistinction to appendiceal fistulae, which tend to heal, such fistulae are persistent and resist operative attempts at closure.

In a consideration of the differential diagnosis, ileocecal tuberculosis, ulcerative colitis, lymphosarcoma, actinomycosis and carcinoma must be borne in mind. The diagnosis of regional ileitis is suggested when one encounters

in an adolescent or young adult the symptoms of chronic small intestinal obstruction accompanied by signs of a low grade inflammatory process with mild fever, slight leukocytosis, loss of weight, a variable degree of anemia and usually a somewhat tender mass palpable in the right lower quadrant or by rectum. The bowel habit is irregular, constipation alternating with diarrhea. Mucus and at times blood are present in the stool.

Conclusive evidence to establish the diagnosis is often furnished by gastrointestinal roentgenography. By barium enema the colon is normal except for a possible pressure defect caused by the mass of agglutinated terminal ileum or the presence of ileocecal fistulae. Occasionally a fistulous tract running to the sigmoid or elsewhere in the colon is demonstrated. If the stenosis is not too great, reflux through the ileocecal valve may demonstrate a narrow, tortuous and fixed terminal ileum. As in other types of obstruction, careful consideration should be given before recourse to the barium meal, as complete obstruction may be initiated. Roentgenography will show the terminal ileum narrowed and fixed for a variable distance. Areas of increased radiance in the narrowed lumen denote polypoid masses of hypertrophied mucous membrane. Above the obstructed segment the bowel is dilated and the passage of the opaque medium is delayed.

The etiology is obscure. The appendix has been implicated by Homans,<sup>9</sup> based on the fact that in the two cases coming under his observation one showed ulceration and the other was partially destroyed by fibrosis. He maintains the vascular relations of the appendix are more favorable to ileal than to cecal involvement. Furthermore, removal of a diseased appendix frequently precedes the onset of the symptoms of regional ileitis. Our experience leads us to believe, however, that an unoffending appendix is not infrequently removed under the erroneous impression that it accounts for the symptoms and the true pathologic condition is unrecognized. In none of our cases where appendectomy had not previously been done was there evidence suggestive of primary appendiceal involvement or ulceration of the mucosa, though frequently it was enmeshed in the inflammatory mass by peri-appendiceal adhesions.

Usually the lesions are so chronic when the case comes to operation that a mixed culture is reported bacteriologically. The only bacteriologic finding of significance that was obtained in this series was in a relatively early case with symptoms of eight weeks' duration. At operation there was a considerable excess of straw-colored fluid. Cultures from this fluid, from the cut surface of the hypertrophied mesenteric lymph nodes and from the deep surface of the intestinal ulcerations, all yielded an anaerobic streptococcus in pure culture. The patient made a smooth convalescence following primary resection.

Repeated efforts by culture, staining reactions and guinea-pig inoculations have failed to demonstrate the tubercle bacillus.

The pathology is characteristically confined to the terminal ileum, ending



abruptly at the ileocecal valve where the process shows its greatest activity, and extending upward for a variable distance, usually a foot or two, where it stops, though not quite so sharply as it does at the ileocecal valve. The involved segment and its mesentery are enormously thickened and doughy without much distortion of the serosal surface except in the more advanced cases



FIG. 1.—(A) Thickened bowel wall. (B) Greatly constricted zone. (C) Dilated ileum. (D) Ileocecal valve. (E) Ulcers.

in which sinuses have formed with resulting deforming adhesions. These sinuses, as already stated, may lead to other coils of ileum, to the cecum, sigmoid or abdominal wall. There is usually some clear free fluid in the peritoneal cavity and the peritoneal surfaces are moderately hyperemic and frequently present a granular appearance simulating slightly the lesions of miliary

# REGIONAL ILEITIS

Fig. 2.—(A) Polyposis. (B) Ulceration. (C) Thickened mesentery. (D) Ileocecal valve. (E) Thin wall outside of lesion. (F) Thickened ileum of process.

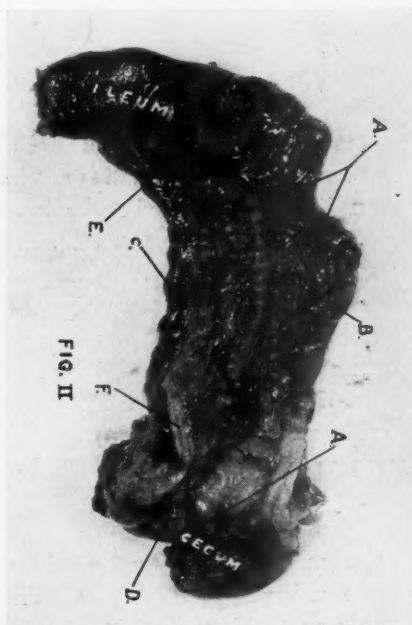


Fig. 3.—(A) Thickened wall of ileum. (B) Thickened mesentery. (C) Polyposis. (D) Ileocecal valve. (E) Edematous mucosa.

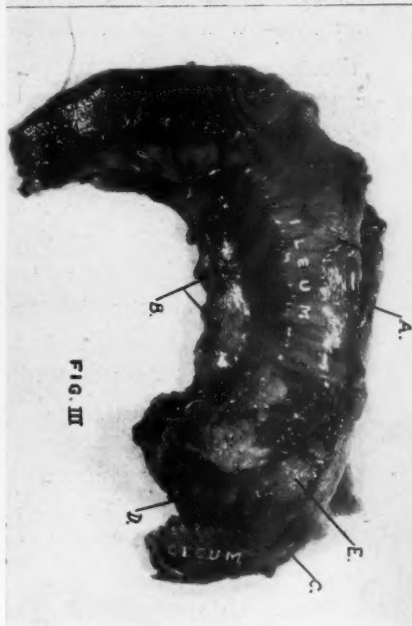


Fig. 4.—(A) Thickened wall of ileum. (B) Indurated mesentery. (C) Serosal roughening. (D) Mesenteric adenitis.

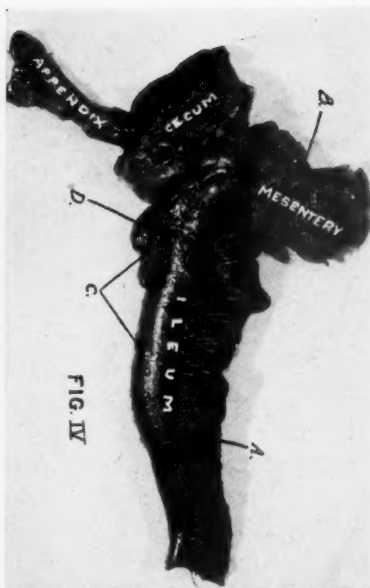
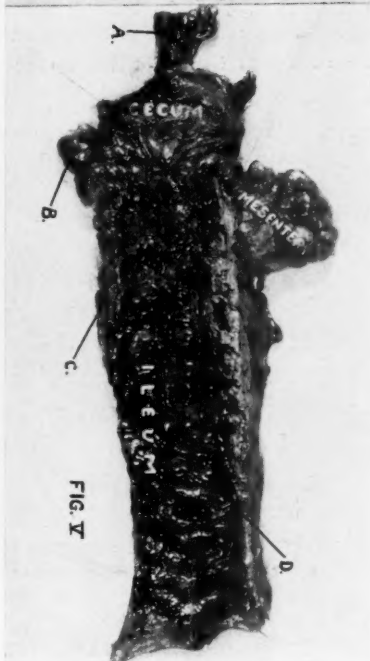


Fig. 5.—(A) Appendix. (B) Mesenteric adenitis. (C) Thickened wall of ileum. (D) Edematous mucosa.



tuberculosis. Numerous hyperplastic mesenteric lymph nodes are found. The cut surface of the gut wall shows the layers especially clearly defined due to

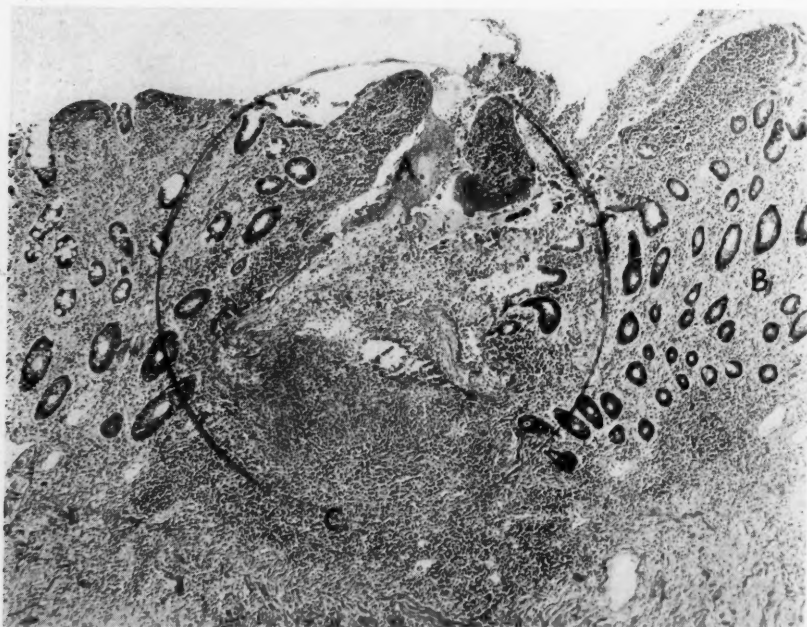


FIG. 6.—(A) Superficial ulceration. (B) Edema of mucosa. (C) Non-specific inflammatory reaction.

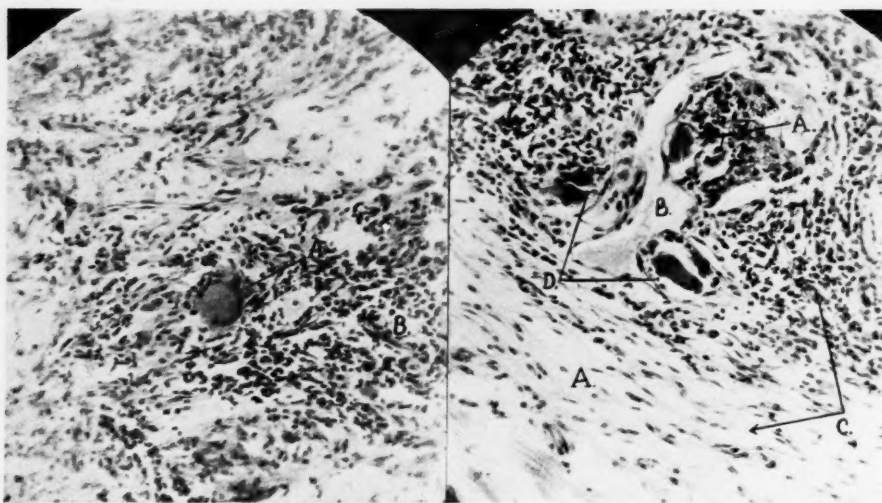


FIG. 7.—(A) Isolated giant cell. (B) Non-specific inflammatory reaction, monocytes and lymphocytes.

FIG. 8.—(A) Marked edema with separation of fibroblasts and ganglion cells. (B) Dilated lymphatics. (C) Edema out of proportion to cellular reaction. (D) Collection of giant cells.

a diffuse edema which is particularly marked in the submucosa and subserosa. The mucosal surface has lost its villous fringes and shows instead a shiny

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cobblestone-like surface with numerous superficial ulcers which tend to concentrate along the mesenteric border. The ulcers show little or no reaction at their edges or base but now and then a sinus can be traced from the base through the wall into the mesentery for a short distance. In the advanced cases such sinuses finally penetrate the mesentery and communicate with neighboring structures. It is only in this stage that a fibrous tissue reaction of any consequence appears.

Microscopically the process resembles a low grade inflammatory reaction characterized by an enormous widespread edema with a mild cellular reaction showing lymphocytes, plasma cells, monocytes and a few eosinophiles. There is little or no fibrin or polymorphonuclear leukocytic reaction except in the

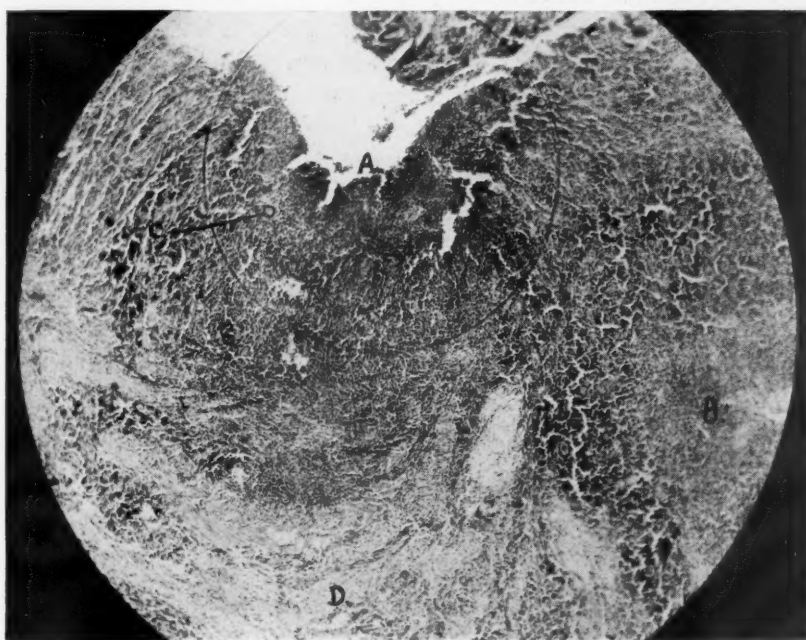


FIG. 9.—(A) Mucosal ulceration, epithelium destroyed. (B) Necrotic area communicating with ulcer forming sinus. (C) Isolated giant cell. (D) Non-specific inflammatory reaction.

region of the ulcers or sinuses. Minute areas of necrosis are scattered about which here and there become transformed into "epithelioid tubercles" but they differ from the picture of tuberculosis in that multinuclear giant cells, though frequently seen, are not found in conjunction with the monocytic cells forming the tubercle. The reaction in general is not unlike what one might expect from a rather avirulent streptococcus infection, an anaerobic strain of which was cultured in pure form from the lymph nodes, peritoneal fluid and from the ulcers in one of our cases.

It is possible that at times lesions in the early stage of the disease may undergo spontaneous resolution, but more frequently they progress to a sub-acute or chronic stage. In one or two instances an unconfirmed diagnosis of regional ileitis has been made in this clinic in which resection or other curative

measures have not been attempted and in which spontaneous cure has apparently resulted. We have operated on only one case that might have been placed in the early phase of the process. Here the signs were of acute right lower quadrant inflammation. Surgery was considered advisable on the basis of a probable appendiceal abscess and when the pathology was revealed an immediate resection and anastomosis was done with prompt recovery. The question may well be raised whether or not a procedure of this magnitude was indicated in the early stage of the disease and whether a temporary ileostomy or ileocolostomy might not have sufficed. In answer it can be said that the disease tends to progress and where graded procedures have been employed we have generally found that the involved segment of bowel has later developed some form of complication, either abscess or fistula, that has rendered resection much more difficult and hazardous. We have had no case in which a cure was accomplished short of this procedure.

In view of the progressive character of the lesion, the treatment is definitely surgical, but the hazards of operative intervention should be emphasized. Operative maneuvers may activate a latent infection and cause a fatal peritonitis or septicemia. Drainage should be avoided when possible as it frequently leads to the formation of fistulae. Resection of the involved segment in one or multiple stages is the ideal procedure. Technically the operation is difficult due to the severe hemorrhage caused by mobilization of the bowel, the extreme thickening of the mesentery and at times the presence of complicating fistulae. The cecum is removed with the terminal ileum, as the ileocecal valve is usually involved, and an end-to-side or side-to-side anastomosis established with the ascending colon. An ileostomy to relieve the suture line is often advantageous.

TABLE II

## Operative results in 11 cases

Recovered.....	7	64%
Died.....	4	36%

## One stage ileocecal resection, 6

Recovered.....	5
Died.....	1
Fulminating peritonitis, ? septicemia 40 hrs. p.-o.	

## Attempted stage resections, 5 (All cases complicated by fistulae or abscesses)

Recovered.....	2
Died.....	3

## Completed stage resections, 3

Recovered.....	2
Died.....	1

Multiple pulmonary infarcts and bronchopneumonia 3 weeks after Mikulicz resection.

## Incompleted stage resections, 2

Died.....	2
1. Fecal fistula and peritonitis; died on 9th p.-o. day.	
2. General peritonitis. Died 36 hrs. p.-o.	



The majority of patients present themselves with definite obstructive symptoms or with abscesses or fistulae, and the indication for surgical intervention is clear. A multiple stage procedure may be indicated with drainage of an abscess as a first step, followed by ileocolostomy and finally resection.

Our best results have been attained by the one stage ileocecal resection and closure without drainage. This type of operation is more readily applicable to the earlier stage of the disease where complications are minimal. Six patients have been so treated with one death. The latter patient was in excellent condition following operation, but died some 40 hours later of a fulminating peritonitis with a probable septicemia.

In five cases resection by multiple stages was attempted. All presented extensive complications. Two patients succumbed following ileocolostomy. In one there was involvement of the terminal eight inches of the ileum with extension to the cecum where a perforation was encountered. Lateral anastomosis with drainage was done. A fecal fistula and peritonitis developed, and the patient died on the ninth postoperative day. The other patient was a poor operative risk with extreme emaciation, anemia and secondary neurologic symptoms. An ileocolostomy was done, but a small chronic granulating cavity was inadvertently opened. It lay between adherent folds of mesentery and contained no gross purulent exudate. The patient developed a virulent peritonitis and died in 36 hours.

Resection was performed in multiple stages three times, with one fatality. The Mikulicz technic was employed twice, the fatal outcome occurring in one of these. The patient was the oldest individual in the series. Preliminary drainage of an ileocecal abscess was followed by resection. Multiple pulmonary infarcts occurred during the second week, and death occurred 21 days after the second operation.

The mortality in the 11 cases comprising this series has been 36 per cent. This high figure may perhaps be accounted for by the fact that six of the cases presented extensive complications at the time of admission. Three of the four deaths were caused by postoperative peritonitis. The remaining death followed multiple pulmonary infarcts. The underlying infection, in spite of its chronicity, we believe to be a virulent one. Adequate resection is apparently curative, as there have been no recurrences to date.

#### CASE REPORTS

CASE I.—Office, No. 9073. March 13, 1930. Male, aged 29. Four years ago onset of epigastric discomfort and occasional vomiting. For ten months attacks of vomiting, sweating and chills. No pain. For nine weeks gas and abdominal distention, pallor and constipation. For ten days colicky pain, nausea and vomiting, diarrhea with watery stools and mucus. Weight loss 35 pounds in four years.

*Significant Physical Findings.*—Distention, right lower quadrant tenderness. Question of mass.

*Laboratory Data.*—Hemoglobin, 65 per cent; red blood cells, 4,500,000; white count,

7,000. Stools contain mucus. Guaiac, negative. Preoperative. Roentgenographic Examination.—Small intestinal obstruction near ileocecal valve. Tuberculin test, negative.

*Operation.*—Lateral ascending ileocolostomy. Amber fluid. Agglutinated mass involving terminal ileum and cecum. Terminal eight inches of ileum greatly dilated. Improvement, but never free from symptoms.

Readmitted May 22, 1934. For seven weeks had had vomiting. Weight loss of seven pounds. No cramps, constipation, diarrhea or blood. Roentgenogram showed no evidence of obstruction but cecum flattened. Probable inflammatory mass at ileocecal valve.

*Laboratory data.*—Hemoglobin, 70 per cent; red blood cells, 4,300,000; white count, 11,000. Stools contained no mucus. Guaiac, negative.

*Operation.*—Appendectomy with drainage. Indurated mass involving terminal ileum and cecum. Hyperplastic mesenteric nodes. Terminal ileum hypertrophied and dilated. Remaining small bowel normal. Lateral anastomosis patent and functioning.

One and one-half months later fecal fistula was established at drainage site. Temporary spontaneous closure followed by malaise, chills, etc. Relief when fistula would reopen. Readmitted April 26, 1935.

*Operation.*—Resection of terminal ileum and ascending colon. Modified Mikulicz technic. Numerous ileocecal fistulae encountered. Good convalescence.

*Pathologic Report.*—The specimen consists of cecum resected about four and one-half inches distal to the ileocecal valve to which are attached about six and one-half inches of terminal ileum. A loop ileocecostomy has been performed, and the ends of this loop are also attached to the specimen, two and three-quarters inches of one end and one and one-half inches of the other. The mucosa of the ileum is diffusely and irregularly ulcerated. The ulcerations are shallow and ragged and tend to extend lengthwise along the longitudinal dimensions of the intestine. The largest measures one and five-eighths by five-eighths inches. The base is red, corrugated into longitudinal folds, granular, apparently bleeding from one small point. In addition to the ulcerations there are several small polypoid formations, sessile in type, the largest measuring four Mm. in diameter. They are firm, of the same color as the surrounding mucosa and not ulcerated. There is a marked constriction at the ileocecal valve where the circumference of the ileum measures only about one and one-quarter inches, and the ulcerations extend down to this point. The ileocecostomy is not remarkable. The anastomosis is apparently an old one and the operative site is in good condition. There are no ulcerations seen in the cecum.

*Diagnosis.*—Regional ileitis.

*Comment.*—The mucous membrane is partially replaced by cellular granular tissue which contains many eosinophilic leukocytes. The muscular coats are thickened by a chronic inflammatory infiltration and fibrosis. There are many lymphoid cell follicles, especially numerous in the submucosa. No epithelioid or giant cells are noted.

It is noteworthy that although the duration of the disease was nine years and ileocecal fistulae were present, pathologic examination of the resected specimen showed no involvement of the large bowel. Spontaneous development of an external fistula followed drainage. This case has been reported somewhat in detail as it is typical of the progressive character of this disease.

CASE II.—B. I. H., No. 12219. September 24, 1931. Male, aged 19. Intermittent right lower quadrant pain of two weeks' duration. Nausea for two days. Vomiting in past 24 hours.

*Physical Findings.*—Generalized abdominal spasm and tenderness in right lower quadrant. Right sided pelvic tenderness on rectal examination. *Laboratory Data.*—White count, 15,200. *Preoperative Diagnosis.*—Acute appendicitis. *Operation.*—Ileocecal resection and ileocolostomy. The terminal ileum and cecum were involved in a large, inflamed, edematous mass. About 24 inches of bowel were resected. Convalescence

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stormy; fecal fistula and wound sepsis. Follow up clinic reports patient well. No gastrointestinal symptoms. Wound well healed.

*Pathologic Report.*—There is a diffuse phlegmonous subacute inflammatory process of the entire bowel wall and mesenteric attachment with mucosal ulcerations. *Diagnosis.*—Regional ileitis. In good health four years later and free of gastro-intestinal symptoms.

CASE III.—B. I. H., No. 10207. January 1, 1932. Male, aged 27. Appendectomy in 1920. Abdominal distress for years. Two previous hospital admissions for colicky abdominal pain and obstipation. Present complaint—diffuse abdominal pain, most severe in left lower quadrant. Bowels irregular.

*Physical Findings.*—Hyperperistalsis, tenderness and question of mass in left lower quadrant. *Laboratory Data.*—Hemoglobin, 80 per cent; white count, 6,400; stool, negative. No preoperative roentgenologic examination was made.

*Operation.*—Resection 18 inches of terminal ileum. Lateral ileocolostomy, ascending ileostomy. Some free fluid present. Mesentery of ileum over one inch in thickness. Severe hemorrhage. Transfusion. Convalescence stormy. Bilateral bronchopneumonia. Partial wound separation. *Follow Up.*—Well and has gained weight. Incision well healed.

*Pathologic Report.*—Acute edematous and ulcerative enteritis. Regional ileitis.

CASE IV.—B. I. H., No. 13298. January 13, 1932. Male, aged 26. Dull intermittent right lower quadrant pain with exacerbations. Nausea. No bowel disturbance.

*Physical Findings.*—Tender, fixed, orange size mass in right lower quadrant.

*Laboratory Data.*—White count, 13,300. Roentgenographic examination showed no abnormality of colon by barium enema.

*Operation.*—Ileocolostomy transverse. No free fluid. Terminal nine inches of ileum inflamed and apparent extension to cecal wall. Four inches above ileocecal valve small perforation (fistula?) found near mesenteric border. Mesentery thickened. Appendectomy. Drained. Postoperative distention marked. Fecal fistula developed on seventh day. Died on ninth day, of peritonitis.

*Pathologic Report.*—Chronic appendicitis. No autopsy obtained.

CASE V.—B. I. H., No. 15261. July 18, 1932. Male, aged 14. Onset of periumbilical pain one and one-half years previously. Occasional attacks of vomiting becoming more severe. Lately diarrhea. Appendectomy three and one-half years before admission.

*Physical Findings.*—Emaciation. Rectal examination revealed soft, rounded, tender mass palpable through anterior rectal wall. *Laboratory Data.*—Hemoglobin, 65 per cent; red blood cells, 5,400,000; white count, 13,000. Roentgenographic examination of gastrointestinal tract showed hypermotility and slight irregularity at ileocecal valve.

*First Operation.*—Exploratory laparotomy; biopsy. Considerable free fluid. Large mass occupied right lower quadrant and extended into pelvis, composed of adherent coils of intestine and edematous mesentery with enlarged nodes. Wick to control hemorrhage.

*Pathologic Report.*—Chronic productive lymphadenitis.

No improvement. Symptoms persisted. No gain in weight. Irregularity of bowel habit developed. Now has diarrhea, eight to ten movements daily.

*Second Operation.*—Resection of cecum and terminal ileum. Ileocolostomy. Inflamed loop of ileum found extending for 14 to 15 inches proximal to ileocecal junction. Terminal inch less involved. Mesentery thickened and contained some hyperplastic nodes. Excess of straw-colored fluid present. Wall of terminal ileum thickened to three-sixteenths of an inch, shading off into normal bowel above. Resection of involved ileum carried out with ileocolostomy.

*Pathologic Report.*—Thirteen inches of ileum submitted, "coiled up." Coiled segment forms hard indurated inflammatory mass with thick bands of adhesions to contiguous loops. There are many enlarged lymph nodes. On opening the lumen decreases in caliber about eight inches from proximal end so that only tip of small finger can pass. Mucosa of narrowed part is coated by yellowish-brown necrotic pseudomembrane. Mesen-

teric aspect of lumen shows several sinus tracts ending blindly in the mesentery. Microscopic examination shows edema, polymorphonuclear infiltration, and inflammatory exudate. In other places thickening by dense fibrous tissue with minimal cellular reaction. *Diagnosis*.—Acute regional ileitis.

Culture of mesenteric node removed at first operation—negative. Culture of abdominal fluid four days after second operation—*B. coli*. Culture of resected specimen—negative. Expired two days after operation of shock and peritonitis.

CASE VI.—B. I. H., No. 17082. January 13, 1933. Male, aged 20. Complaint—intermittent draining sinus in right lower quadrant. This followed appendectomy with drainage at another hospital. The pathologic report was obtained. *Diagnosis*.—Chronic appendicitis. *Laboratory Data*.—Blood, serology and stools negative. *Roentgenologic Examination*.—Gastro-intestinal series revealed irregularity of cecum and narrowing and fixity of terminal ileum.

*First Operation*.—Several fistulous tracts about the ileocecal valve were closed, and an ileostomy performed. Slow but complete healing.

Reentry 16½ months later because of repeated attacks of abdominal cramps and diarrhea alternating with constipation. Occasional fever.

*Physical Findings*.—Diffuse right lower quadrant tenderness on rectal examination. White count, 10,500; stools, negative.

*Roentgenologic Examination* of gastro-intestinal series essentially the same as previously. *Preoperative Diagnosis*.—Regional ileitis.

*Second Operation*.—Ileocecal resection. End-to-side ascending ileocolostomy. Terminal ten inches of ileum thickened, congested and adherent. The cecum was not involved. Convalescence not remarkable except for some wound sepsis and diarrhea.

Reentry eight weeks later for residual abscess. Ileostomy and drainage. In the course of the next eight months several further procedures were required before the ileostomy sinus and obstructive symptoms finally subsided. For the past 18 months he has been free from symptoms. Lately an inguinal hernia has been repaired. Recent gastro-intestinal roentgenographic study reveals no evidence of obstruction or residual inflammatory disease.

*Pathologic Report*.—Twelve inch loop of bowel consisting of terminal ileum and small portion of cecum. Mesenteric attachment considerably thickened in the distal part of ileum. Roughened granular areas on serosa of terminal five inches of ileum on anti-mesenteric surface. Cecum not thickened. Fistulous tract present from cecum extending into lumen of ileum. Fistulous opening surrounded by polypoid and swollen mucous membrane. Lumen of ileum very much narrowed. Mucosa reveals numerous polypoid projections. Fibrin and purulent exudate fills folds and extends in streak-like fashion over mucosa. Section through ileocecal region shows numerous small circumscribed abscesses. Microscopic examination shows extreme congestion, inflammation, exudate and polymorphonuclear infiltration. Occasional giant cells are seen. *Bacteriology*.—Guinea-pig negative for tuberculosis. Smear shows streptococcus. No culture. *Diagnosis*.—Regional ileitis.

CASE VII.—B. I. H., No. 17559. February 27, 1933. Female, aged 14. Complaint—abdominal pain of eight weeks' duration. Intermittent in both lower quadrants, worse on right. Anorexia, nausea and vomiting on one occasion.

*Physical Findings*.—Firm, slightly tender, sausage shaped mass in right lower quadrant. *Laboratory Data*.—Hemoglobin, 80 per cent; red blood cells, 4,400,000; white count, 13,200; stool, liquid brown. Guaiac, 4+. *Roentgenographic Examination*.—Gastro-intestinal series: ileum markedly dilated, atonic and fixed. *Preoperative Diagnosis*.—Regional ileitis.

*Operation*.—Ileocecal resection. Lateral ileocolostomy ascending. Ileostomy. Free fluid with flecks of fibrin. Eight to ten inches of terminal ileum involved. Cecum and appendix, which was non-adherent, free of involvement. Closure without drainage. Excellent convalescence. Follow up 17 months later: Well, no complaints. Occasional

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intestinal gurgling, usually at night. *Bacteriologic Report*.—Cultures from the peritoneal fluid, lymph nodes, ulcerative areas and advancing border of the lesion all grew streptococci in Bargin's brain broth.

*Pathologic Report*.—Non-specific granuloma of ileum with ulceration and edema. Regional ileitis.

CASE VIII.—B. I. H., No. 19648. September 1, 1933. Male, aged 56. Complaint—abdominal pain before and after meals, of eight months' duration. Epigastric and right upper quadrant. Anorexia, nausea, vomiting and weakness. Loss of weight, 20 pounds in five months. Constipation, one month.

*Physical Findings*.—Firm, irregular orange size movable mass to right of umbilicus. Marked emphysema of lungs. Arteriosclerosis. *Laboratory Data*.—Hemoglobin, 60 per cent; red blood cells, 4,000,000; white count, 10,400; stool, liquid yellow. Guaiac, 2+. No mucus. *Roentgenologic Examination*.—Preoperative. There is a crescentic pressure defect on terminal ileum. Barium enema. Entire colon well outlined and regular. Ileocecal valve not patent.

*First Operation*.—Drainage ileocecal abscess. Ileostomy. Free fluid. Large inflammatory mass in region of cecum. Appendix and cecum appeared normal. Terminal ileum composing mass, thickened and engorged. Mesentery edematous. Abscess in center of inflammatory mass containing one ounce of creamy pus, drained. Convalescence fair. Urinary retention. Attacks of cramps and low distention. Second stage three and a half weeks later.

*Second Operation*.—Ileocecal exteriorization (Mikulicz). An ileal fistula to appendix and numerous adhesions encountered. No involvement of large bowel. Cecum and eight inches of terminal ileum exteriorized.

Mass resected on ninth postoperative day. Developed bronchopneumonia and repeated attacks simulating pulmonary infarction. Abdomen soft. Satisfactory fecal discharge from ileum. Grew progressively worse. Died three weeks following second operation. Autopsy not obtained. *Bacteriologic Report*.—After two days abscess shows *B. coli* on culture. After two days peritoneal fluid negative.

CASE IX.—B. I. H., No. 21119. January 19, 1934. Female, aged 27. Complaint—midabdominal pain and diarrhea. Colicky pain began 21 months ago, at first related to umbilical region. Later also in right lower quadrant. Nausea. Vomiting and loss of weight. Diarrhea for one year. Appendectomy three months after onset without relief.

*Physical Findings*.—Marked loss of weights. Lower abdominal distention. Tenderness and doughy resistance in right lower quadrant. Marked neurologic changes including nystagmus, increased tendon reflexes, ankle clonus and disturbed thermal sensitivity. *Laboratory Data*.—Hemoglobin, 70 per cent; red blood cells, 3,600,000; white count, 8000; stools, foul, liquid, gray-black. *Roentgenographic Examination*.—Preoperative. Spasm of ileum. Sigmoid appeared irregular and narrowed. Barium enema not tolerated.

*Operation*.—Ileocolostomy ascending. Cecum and large bowel normal except for adhesions between sigmoid. In exploration a very small cavity filled with granulation tissue but no pus was opened (ileosigmoid fistula?). Over one foot of terminal ileum was dilated and indurated, the mesentery thickened and containing hyperplastic nodes. Palpation of ileocecal valve revealed polypoid masses projecting into cecum. Attempts at mobilization followed by brisk hemorrhage; therefore anastomosis done as first stage of two stage resection. Incision closed without drainage. *Course*.—Rapidly fatal with all signs of a generalized peritonitis.

*Comment*.—It seems possible that a fistula not recognized preoperatively by roentgenography or at operation may have been opened causing peritonitis. Another possibility is the activation of a latent infection by opening a chronic abscess cavity. Drainage of the cavity with ileostomy above the involved segment would have been the proper surgical procedure.



CASE X.—B. I. H., No. 21412. February 14, 1934. Female, aged 29. Complaint—diarrhea of eight months' duration. Upper abdominal pain at onset but for two months cramp-like across lower abdomen. Appendectomy three years ago.

*Physical Findings.*—Loss of weight. Tenderness and resistance over entire right side of abdomen. *Laboratory Data.*—Hemoglobin, 55 per cent; red blood cells, 3,000,000; white count, 7000; stool, brown, loose formed. *Roentgenographic Examination.*—Pre-operative. No characteristic findings. Distended loops of bowel that appeared to be small intestine.

*Operation.*—Ileocecal resection. Lateral ileocolostomy ascending. Ileostomy. Small intestine dilated. Terminal eight inches of ileum thickened and inflamed, involvement apparently including the cecum. Mesentery indurated and swollen, containing hyperplastic nodes. Convalescence satisfactory aside from temporary postoperative shock. The patient has remained well.

*Pathologic Report.*—The specimen presents the typical appearance of non-specific ulcerative enteritis involving the terminal ileum. Numerous sinuses run from the ileum to the cecum and also blindly into the mesentery but the mucosa of the cecum shows no evidence of involvement. *Diagnosis.*—Regional ileitis.

CASE XI.—B. I. H., No. 25204. December 29, 1934. Male, aged 21. Complaint—colicky abdominal pain, diarrhea and constipation. For four years had constipation alternating with diarrhea. Cramp-like pain across lower abdomen for seven months. Loss of 14 pounds in weight last two months.

*Physical Findings.*—Moderate abdominal distention, visible peristalsis, fulness, resistance and tenderness in right lower quadrant of abdomen. *Roentgenographic Examination.*—Preoperative. Flat film revealed poorly defined mass filling right lower quadrant. *Laboratory Data.*—Hemoglobin, 70 per cent; red blood cells, 4,400,000; white count, not made; stools, guaiac strongly positive.

*Operation.*—Ileocecal resection. Ileocolostomy ascending. Ileostomy. Ileum much thickened and dilated for distance of about nine and one-half inches covered with fibrin. Small amount of fluid present in abdomen. Lumen of ileum narrowed in involved portion. Terminal ileum and part of cecum resected. Kerr end-to-end anastomosis and ileostomy performed. Convalescence excellent except for one grossly bloody stool on eleventh postoperative day. Patient has remained well.

*Pathologic Report.*—Twenty inches of terminal ileum and portion of cecum including appendix. Hyperplastic process begins 14 inches proximal to ileocecal valve where there is apparent obstruction. Proximal to this ileum greatly dilated, wall of bowel thickened due to edema of mucosa and submucosa. Mucosa of involved segment ulcerated with numerous superficial irregular ulcers. Process ends sharply at both ends. Deep erosions present all along mesenteric line, worse at proximal end, where there is a purse-string-like obstruction. Microscopic examination shows edema, inflammatory exudate and ulceration of involved bowel. *Diagnosis.*—Regional ileitis with ulceration. *Bacteriologic Findings.*—Guinea pig killed February 28, 1935. Negative for tuberculosis. No other organisms cultured.

#### SUMMARY

The term "regional ileitis" has been applied to a localized, non-specific enteritis of the terminal ileum.

A high incidence of the lesion is found among Hebrews.

Characteristically it affects young adults.

It is a well defined clinical entity, having a suggestive history that is corroborated by the physical examination and laboratory findings.

It is progressive in character with a tendency to develop partial intestinal obstruction, internal or external fistulae, and abscesses.

The treatment is surgical.

The preferable operative attack is by a one stage resection in uncomplicated cases.

Multiple stage operations are frequently indicated when abscesses or fistulae exist.

The surgical mortality is high, due to the large number of complicated cases encountered and the virulence of the underlying infection.

Recurrence has not occurred in the cases resected.

I wish to express my thanks to Drs. D. F. Jones, Carl Bearse, and R. H. Smithwick for permission to use cases from their private records.

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DISCUSSION.—DR. HORACE BINNEY (Boston, Mass.).—My interest in this subject is rather recent. I have had only two personal cases, both in young adults. A diagnosis was not made preoperatively in one, but was made before the second stage in the other.

The first case was one involving the lower ileum and small portion of the cecum with an abscess encountered at exploration for what we supposed was tuberculosis, and in spite of that abscess I was able to do a temporary first stage ileocolostomy, anastomosing the ileum to the transverse colon. About nine months later a fistula developed where the abscess was, but in spite of the fistula I was able to do a resection, and the patient has done very well.

In the second case a fistula was also present, but I was able to do a resection and end-to-end anastomosis. The patient was well at the end of six months.

Regional ileitis is an interesting surgical condition because of the variety of its manifestations and the apparent mystery as to cause. Also on account of its bizarre behavior in some cases, *e.g.*, cases in fairly early stage and involving several inches of the ileum, operated on under diagnosis of acute or subacute appendicitis, may go for years without further trouble simply with the removal of a chronic appendix. Again, removal of a segment of diseased bowel with adequate margins of healthy tissue may be followed quite quickly by recurrence in another portion of the ileum. Such a case is reported by Homans.

As to diagnosis, I agree that the early stages are so closely simulated by appendicitis that the true diagnosis is probably impossible preoperatively.

In the stages of ulceration, obstruction and tumor formation, or fistula externally, if one is looking for this condition the diagnosis should be frequently made. The blood in the stools, if present, is occult rather than the free blood of other forms of ulceration. The obstruction is slow in development and partial. The tumor is of slow growth which should differentiate this condition from most other forms of neoplasm: possibly not in the case of actinomycosis which, however, is very rare. Both the ulceration and fistula types may suggest tuberculosis, but the bacilli will be lacking from the stools. Doubtless in the future the diagnosis will be made much more often than in the past.

In advanced cases in poor risks, through age or other factors, ileocolostomy alone may be enough to restore the patient's health. Possibly, roentgen ray treatment may prove useful. Ileostomy alone would not seem to me of much value.

Doctor Mixter mentions severe hemorrhage as one of the dangers in attempting resection. It would seem that this procedure should, therefore, be avoided in the early stages, when hyperemia is marked, and that a preliminary exclusion by ileocolostomy would be safer, before resection is undertaken.

To clear up our knowledge of the subject, there is certainly need of more critical study by pathologists and of a much more close follow up of the so called subacute appendicitis cases which apparently are occurring frequently in our hospitals, some of which may well be early stages of this malady.

DR. EDWIN BEER (New York, N. Y.).—This interesting paper calls attention to a condition which has been overlooked apparently by pathologists and clinicians. Time alone will tell how frequently it occurs. In studying diverticulitis of the colon some 32 years ago, another condition which had been overlooked, I found in the literature only 18 reported cases. Ten years later, in studying diverticulitis of the bladder, I found the same situation obtained: there were only 10 or 12 reported cases which had been recognized and treated. Everybody now recognizes both these conditions as rather frequent occurrences, and I wonder whether regional ileitis will show similar frequency of occurrence. I am inclined to think that the condition is much more frequent than we realize and frequently goes, unrecognized. Many of these cases masquerade as appendicitis, and a few years ago such a case presented itself to me with a fecal fistula, having been operated upon for appendicitis, which was followed by an intestinal fistula, and then reoperated on for closure of the fistula. There was a persistent fecal fistula when the patient was seen by me, and ileocecal resection cured the condition and showed in the lumen of the ileum a chronic, non-specific ulceration.

## REGIONAL ILEITIS

As most of the speakers have said, many of these cases look like subacute appendicitis or chronic appendicitis and occasionally may show a narrowing of the lower lumen, as seen in Doctor Lee's presentation. Many cases present a mass in the right iliac fossa, which suggests either the above type of appendicitis or ileocecal tuberculosis. Following removal of the appendix, development of a fecal fistula or a slowly healing wound often suggests tuberculosis, though there is no evidence of tuberculosis in the removed appendix. Some of these cases of chronic fistulization are undoubtedly ileitis, and unless one has a chance to revise the wound the original surgeon fails to correct his primary impression.

In addition to external fistulization, many of these cases form a fistula between loops of bowel, and one of the series which I have seen was operated on for appendicitis and came to me with a large abscess in the abdominal wall. Subsequently the patient developed a fistula between the ileum and sigmoid, as well as a large retroperitoneal abscess which perforated into the left ureter.

It is essential in all these cases to recognize the condition early and resect, preferably ileocecal resection of the bowel, for untreated most of these cases go slowly down hill and are chronic invalids, many of them, as I said, masquerading as chronic intestinal tuberculosis.

DR. WALTER E. LEE (Philadelphia, Pa.).—We present a case of terminal or regional ileitis with the object of calling attention to the fact that this condition has been recognized in Philadelphia, and that, strange as it may seem, the underlying factors of race and youth which Doctor Mixter and Doctor Beer have emphasized are not confined to the cities of Boston and New York.

### CASE REPORT

A Jewish multipara, 28 years of age, came to the gastro-intestinal clinic of the Graduate Hospital of the University of Pennsylvania in September, 1933, complaining of diarrhea of three months' duration and lower abdominal pain. The lesion was not diagnosed at that time and although she did not attend the clinic regularly, when she was admitted to the hospital one year later she had lost 46 pounds. There had been no long remission of symptoms during this interval of a year, and the tendency toward diarrhea and vague lower abdominal pain recurred rather frequently. About two months previous to admission her symptoms became aggravated and there was more severe pain in the region of the umbilicus and the lower right quadrant, associated with increased peristalsis and at times vomiting. The attacks suggested partial bowel obstruction. About this time there began an evening rise of her temperature to 101° F., and night sweats became a frequent complaint. The diagnosis of regional ileitis involving the terminal ileum was based upon the following:

- (1) A long history of intermittent attacks of pain in the lower abdomen and lower right quadrant. There was mucous diarrhea but without tenesmus.
- (2) Tenderness and muscle guarding in the lower right quadrant associated with a movable, palpable mass corresponding to the position of the terminal ileum.
- (3) A persistent string sign in the terminal ileum, in the radiographic films.
- (4) Absence of any clinical or radiographic evidence of tuberculosis, and the absence of signs of tuberculosis or any other type of intrinsic lesion in the cecum.

We performed a two stage operation because of an unfortunate experience following a one stage operation in the first case which we had encountered two years previously and did not recognize. At the first operation a laparotomy was performed through a lower right rectus incision and it was found that the terminal ileum and ileocecal valve were fixed and could not be delivered. About 16 to 17 cm. of the terminal ileum were covered by a fibrosed stenotic exudate and the glistening sheen of the wall, was absent. The walls were greatly thickened and rigid, feeling somewhat like a garden hose. Proxi-

mal to this region for a distance of seven cm. there was a more acute reaction in the serosa, the vessels being engorged and the fibrosed stenotic exudate merging gradually into a plastic exudate. Still further on, beginning at a distance of 24 cm. from the ileocecal junction, the diseased segment quite abruptly merged into normal appearing bowel. The mesentery of the distal 24 cm. of the ileum was thickened and boggy, and there were several enlarged lymph nodes in the base of the mesentery near the ileocecal junction. The presenting surface of the cecum and ascending colon did not appear or feel to be involved, but in the appendiceal region the cecum was tightly fused to the ileum by a well organized fibrotic membrane. The appendix was not visible nor could it be palpated in spite of a careful search. There was no evidence of fistula formation. While manipulating the bowel about two to three cc. of cream colored pus escaped from the base of the mesentery where it was adherent to the cecum, a culture of which was reported as containing, *B. proteus*. Because of the free pus it was deemed unwise to do more than a short circuiting anastomosis between the terminal ileum and the transverse colon. Convalescence from this first stage was uneventful.

At the second operation, after an interval of 16 days, we found no important change in the gross pathology seen at the first operation other than a few fine fibrous adhesions at the site of our previous operative field. At this stage the ileum was transected about eight cm. distal to the anastomosis and the proximal open end was inverted. The transverse colon was then transected about the same distance from the anastomosis and its open end inverted, following which the terminal ileum, appendix, cecum, ascending colon and a portion of the transverse colon were excised. The abdomen was closed without drainage. An uneventful convalescence followed. About six months later she had gained 34 pounds and was having two or three normal bowel movements daily and had returned to her household duties.

A follow up study with a barium enema at this time showed that the ileocolostomy was functioning properly.

DR. EMIL GOETSCH (Brooklyn, N. Y.).—I have had one experience recently with regional ileitis. This was a few months ago, before I had become at all familiar with this disease. Since I had an opportunity to study this condition and to operate for it, I became interested and had an opportunity to review Doctor Krohn's series of cases which were reported from the Mt. Sinai Hospital in New York City.

I thoroughly agree with the statement of Doctor Mixter concerning the great difficulty in handling the mesentery which so often is enormously thickened, very fragile and extremely vascular. In addition in these cases, as in mine, there was a large segment of small bowel firmly adherent and bound up in one large mass in the right lower part of the abdomen. I should like to emphasize the very extensive nature of the operation which must be seriously considered particularly in the patient who is often not in the best of condition. Consequently it might be well, as was pointed out in Doctor Krohn's paper, to adopt the two stage operation, namely an ileocolostomy as the first stage and then after a period possibly of even several months, resection of the diseased small bowel in the second stage. This would allow for some subsidence of the inflammation and the edema, and the ultimate operative results might be better.

As you see, the mortality in the series here reported was over 33 1/3 per cent, which in a way seems very high. It would seem that after ileocolostomy in these cases obstruction might occur following contraction in the large amount of diseased adherent small bowel in the region of the terminal ileum, but strikingly this is not the case. In spite of the extensive fibrosis, inequalities in the caliber of the lumen, strictures and dilatations and even perforations, obstruction is not common.



In my case, the primary resection was rather well borne, but the patient died a few days after operation from general asthenia. I have felt that this fatal outcome might have been avoided had I done a two stage operation. I make this suggestion in general in the hope that the rather high mortality of primary resection may be reduced.

DR. HAROLD BRUNN (San Francisco, Calif.).—Crohn and his co-workers have done a real service in describing an entity which passed under various names and more or less defied classification. A group of us reported three cases soon after Crohn's paper appeared and since that time we have had two more cases.

The first case was that of a young lady who had been operated upon for appendicitis. A mass was found in the center of which was an abscess between the cecum and the ileum. The appendix, however, was quite normal. This mass was hard and fibrous and was drained. The patient made a good recovery and was discharged. During this interval we were fortunate to read Crohn's paper, and later when the patient developed signs of obstruction we recognized the case as belonging to this group. A resection was satisfactorily performed, and the patient recovered.

Our most interesting case was that of a young medical student, 24 years of age, who had had cramp-like pains in his abdomen from the time he was 11 years of age. His health, however, was fairly good for many years except that he was always thin and anemic in appearance. His present illness started in July, 1932, when he had continuous attacks of abdominal cramps, nausea and vomiting. At this time a diagnosis of pyloric spasm was made with etiology undetermined. In December, 1933, he reentered the hospital with abdominal cramps and a loss of 20 pounds during the preceding five months. His symptoms now were so severe that he was incapacitated. Roentgenography showed the jejunum to have four large dilatations with constrictions between them.

The patient was operated upon and the bowel removed and a side-to-side anastomosis made, but the patient died.

It was because of this case involving the jejunum that we felt the name regional ileitis did not apply and therefore considered changing the name to making it more inclusive and suggested chronic cicatrizing enteritis as a more descriptive term. However, regional ileitis seems to be accepted by the profession and will no doubt keep its place in the literature in spite of the fact that it is not entirely descriptive.

I was interested in the observation made that this disease appears to be more frequent among Hebrews. Of the five cases we have had all but one occurred in the Jewish race.

DR. EMMET RIXFORD (San Francisco, Calif.).—I suspect that regional ileitis or enteritis is perhaps more common than we ordinarily think. Most of the cases described by Doctor Mixter are chronic cases. Acute cases are not uncommon, and I have had the experience of operating upon a few of them under the diagnosis of appendicitis. In a recent instance in the person of a young physician: Leukocytes, 15,000; slight tenderness in region of appendix; slight fever; mouth temperature, 100°; pulse, 90. On operation the lower two and one-half or three inches of the ileum was seen to be engorged, in active peristalsis, red, swollen and covered with an exudate. The appendix seemed quite innocent but was removed for bacteriologic examination. Some enlargement of the mesenteric lymph nodes. Prompt recovery. There has been no recurrence in the past eight years.

In 1894 I was a very young man, young in surgery. One of my classmates who was much more of a student than I had a copy of Reginald Heber Fitz's paper on appendicitis, as well as Talamon's article. He therefore knew much more about appendicitis than I did. He was suddenly seized with acute abdominal pain, with localized tenderness, and made up his mind from his reading that he had acute appendicitis. It was before the days of the leukocyte count. I could not dispute his diagnosis. He said, "I must be operated upon." I demurred, whereupon he said, "If I die I wish you to perform an autopsy, and if you find that I could have been saved by operation, as a friend of mine you see to it that it is put upon my gravestone, 'Robert J., died a martyr of conservative surgery.'" The best that I could do under the circumstances was to go to my old preceptor, Dr. Levi Cooper Lane. Being a very wise man Doctor Lane said, "Do not operate but call Dr. Clinton Cushing." Cushing said, "Are you sure it is not typhoid fever?" He thought best however to open the abdomen whereupon it was evident that the lower foot or more of the ileum was in violent peristalsis, mesenteric nodes greatly enlarged. One of these nodes was removed for microscopic examination and nothing further was done. Patient went through a very stormy session with typical typhoid fever. I mention this case not merely for the dramatic story (patient finally got well) but to call attention to the fact that typhoid fever has been so nearly eliminated by our public health propaganda that we do not have enough cases these days to properly teach our students. Possibly some more modern student will operate for appendicitis in acute typhoid ileitis.

DR. CHARLES G. MIXTER (Boston, Mass).—I wish to express my thanks for this liberal discussion. There are two things I do want to speak of. The first is the question of etiology. It is obscure, and bacteriologically we have only a suggestion thus far to follow.

As far as the appendix goes, I believe that certainly not all cases can be traced to any appendiceal involvement, because we have had those cases in which the lesion was inspected at a relatively early date in which the appendix was apparently not involved at all. Furthermore, we have seen no case in which the mucosal evidence was such as to lead us to consider it a primary cause.

The sequence of operative procedure, I think, is extremely interesting to consider because although our mortality has been high, our high percentage occurred in complicated cases. I believe that there are a certain number of cases that are spontaneously arrested and resolve. I have not included them in this list, but we have seen two such cases at the operating table that have apparently later subsided spontaneously.

On the other hand, we have seen a very considerable number of cases that have progressed from a simple primary lesion without demonstrable fistulae or abscesses, that progress following a stage procedure. They form abscesses and fistulae later, and the secondary operation is definitely more hazardous. Furthermore, the inflammatory reaction has not appreciably subsided by the side tracking procedure and there still is an edematous, engorged and inflamed mesentery which bleeds freely and causes you as much difficulty as it would have had originally. Furthermore the risks of fistulae and abscess formation are added.

## NON-SPECIFIC GRANULOMA OF ILEOCECAL REGION

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SINCE the appearance of Tietze's<sup>1</sup> report in 1920 upon "Inflammatory Tumors of the Large Intestine," there has been a growing interest in this pathologic condition and consequently an increasing amount of attention paid to the subject by pathologists and surgeons.

Although Dalziel,<sup>2</sup> in England, called attention in 1913 to an inflammatory condition which he termed "chronic interstitial enteritis," involving parts of both small and large intestine, there appears to have been no other publication in the English language until 1923 when Moschowitz and Wilensky<sup>3</sup> of New York reported on "Non-Specific Granuloma of the Intestine." Since then in America an increasing interest has been shown, and comprehensive reports were made by Mock<sup>4</sup> (1931), Crohn, Ginzburg and Oppenheimer<sup>5</sup> (1932), and Ginzburg and Oppenheimer<sup>6</sup> (1933). In these articles the clinical similarity of "non-specific granuloma" to other conditions, notably hypertrophic tuberculosis, was emphasized, and the pathology, symptomatology and clinical appearances fully described. The importance of the subject, due to the difficulties in diagnosis, and lack of uniformity in methods of treatment, has led to the publication by many authors of personal case reports, chiefly of conditions involving the lower end of the ileum, and using the terms "terminal" or "regional ileitis" as suggested by Crohn, Ginzburg and Oppenheimer. The latter authors considered the condition affecting the terminal ileum and ileocecal region to be a pathologic entity. Homans,<sup>7</sup> who reported two cases in 1933, takes issue with them on this point. In his discussion of the pathology, he points out the identity of the pathologic lesion in the small intestine with granuloma of the various parts of the large intestine but admits that "regional ileitis" should be considered a clinical entity. Certainly the rather striking—although variable—characteristics of the disease in this region differentiate it from that in other portions of the bowel and the tendency to so group these cases is reasonable. The relatively large number of reported cases in the past few years, of lesions in the lower ileum or ileocecal region, supports this view.

A personal experience with two cases during the past two years has led the writer to a study of the reports, in this country and England, upon cases involving the lower ileum or ileocecal region. The purpose of this article is to present the clinical findings, diagnostic difficulties and results of treatment of this group of cases. This report is chiefly concerned with disease of the lower ileum and ileocecal region, of which there have been collected 24 from the literature, to which the writer's two personal cases are added,

making a group of 26 cases (Table I). In a few of the included cases the disease was more generalized.

*Etiology.*—In this series the youngest patient was five years old, the oldest, 64. The largest number by decades was between 20 and 30 years, 26 per cent. (5 to 10, 3 cases; 11 to 15, 1 case; 16 to 20, 4 cases; 21 to 25, 3 cases; 26 to 30, 4 cases; 31 to 35, 1 case; 36 to 40, 1 case; 41 to 45, 2 cases; 46 to 50, 2 cases; 51 to 55, 1 case; 56 to 60, 1 case; 61 to 65, 1 case; 2 ages not stated).

As to predisposing causes, there appears to be no constant factor in the way of previous disease, habit or circumstance of life bearing upon the condition of the gastro-intestinal tract. A possible exception exists in the history of our two cases, in both of which a suspicion of tuberculosis of the nodes at the hilum, and in one of concurrent mesenteric and spinal involvement. This point will be discussed later in the article.

*Bacteriology.*—Repeated attempts to demonstrate specific organisms by different pathologists have uniformly failed. In a few reported cases streptococci were found, as was the case in both of ours.

*Pathology.*—In only a few of the cases were full pathologic reports given. Those adequately described agree closely, both in gross appearance and microscopic detail, with the description given by Ginzburg and Oppenheimer. This is a concise summary of the process and is worth quoting here. "The persistence of infection or inability of the intestine to overcome it leads to a series of reparative and destructive processes, resulting in the formation of either hypertrophic peri-intestinal masses or extensive intramural hypertrophic ulcerative and stenosing lesions or a combination of both." The microscope shows "various stages of acute or chronic inflammation with infiltration by lymphocytes, polymorphonuclear leukocytes, plasma cells and mast cells, with varying degrees of fibroblastic proliferation, and often degenerative changes. Giant cells are common, probably due to particles of vegetable matter entrapped in ulcers. These may form nodules which, when present in the serous layer, are difficult to distinguish from tubercles. These 'vegetable' cells may be responsible for hyperplastic fibrosis. To this should be added the occasional presence of abscess, due to perforation of an ulcer, and doubtless explaining the development of fistulae between adjacent portions of bowel, or into other organs or even through the abdominal wall. If the perforation is into the abdominal cavity, a peritoneal abscess results." According to Ginzburg and Oppenheimer, in "regional ileitis" the lesion is most marked at the ileocecal valve and diminishes proximally, rarely extending higher than 12 to 15 inches: the process starts with ulceration along the mesenteric side of the bowel; in the second stage there is perforation or extreme proliferation in the submucosa, the third stage being a conversion of the terminal ileum into a thickened, rigid, hose-like tube. Linear ulcerations along the mesenteric border are common, while near the cecum the mucosa is atrophic with papillary excrescences, especially near the ileocecal valve.

*Clinical Picture.*—With such a variety of pathologic conditions in the different stages of the process, it follows that the symptoms will vary greatly in different cases. Ginzburg and Oppenheimer describe four clinical types, as follows:

(1) *Symptoms Simulating Appendicitis.*—The majority of cases fall under this head. While the picture is not clear cut, in general the symptoms point definitely to the right lower quadrant, beginning with localized pain, with more or less spasm and tenderness. If accompanied with fever, nausea or vomiting and leukocytosis the picture naturally suggests acute appendicitis. The symptoms may be mild and recurrent; however, diarrhea or constipation may occur and in many cases the picture is of so called chronic appendicitis. In our collected series the diagnosis was appendicitis, or the appendix had previously been removed, in 14 cases (53.8 per cent).

At operation the lower ileum is found to be soggy and edematous with large nodes in the mesentery, or in some cases abscess is already present. Drainage may be followed by fistula, or primary healing may occur with secondary breaking down, weeks or months later (Ginzburg and Oppenheimer). This was the case in both of our personal cases, and in 19 per cent of the series.

In a recent case at the Boston City Hospital, a boy of nine years, operated upon by Dr. N. C. Browder (not included in the series), there was bloody fluid in the abdomen, the appendix was normal, the lower ileum showed hemorrhagic areas varying from one to five inches in length—and enlarged mesenteric nodes were found. Such a picture suggests typhoid but there was a leukocytosis and the patient made a prompt recovery after operation (appendectomy). Possibly it represents ileitis in an early stage.

(2) *Symptoms of Ulcerative Colitis.*—This type is rather uncommon and shows diarrhea, loss of weight and strength, secondary anemia and mild colicky pains. Of the series, only two seem to fit into this group at the time the lesion was recognized. Both of Homans' cases gave a previous history of diarrhea, but had progressed to the stage of partial obstruction and palpable tumor when seen by him. The stools show occult blood rather than free blood of ulcerative colitis.

(3) *Symptoms of Chronic Partial Obstruction.*—Ginzburg and Oppenheimer found this the most common type, sometimes preceded by the first or second. Cramps, borborygmi and visible peristalsis are prominent symptoms often lasting from one to three years. Sooner or later a mass develops, leading to the diagnosis of hyperplastic tuberculosis or neoplasm. Eleven of the 26 cases were of this type (42 per cent).

(4) *Chronic Intractable Fistulae.*—Both of our cases developed a fistula, one after appendectomy and recurring after attempted closure; the second followed drainage of abscess found at the first operation. In the series, four (15 per cent) were of this group.



TABLE I

Reporter	Year	Sex	Age	Duration Symptoms sev. wks.	Diagnosis	Physical Examination	Appendec- tomy Exploration	Ileocolos- tomy	Resection	Pathologic Report	Results
1. Dalziel <sup>2</sup>	1913				Subacute ob- struction					Chronic in- terstitial enteritis	Death
2. Moschowitz and Wilensky <sup>3</sup>	1923	M.	23	2 yrs.	1919 chronic diarrhea, 1922 acute obstruction		1 yr. previ- ously	1919	Cecum, 1919. Ileum, 1920	Granuloma ?	Fistula, 1919. Perforation, 1922. Recovery
3. Moschowitz and Wilensky <sup>3</sup>	1923	M.	33	8 days	Subacute typhlitis	Tenderness r. l. q.	2½ yrs. before	1920	Cecum	Granuloma ?	Well 1 yr. later
4. Moschowitz and Wilensky <sup>3</sup>	1923	F.	44	3 wks.	Tumor	Tenderness r. l. q.	—	+	+	Granuloma ?	Well 1 yr. later
5. Friedenwald <sup>11</sup>	1932	M.	50	?	Obstruction	Tumor of cecum	—	+	—	—	Recovery
6. Friedenwald <sup>11</sup>	1932	F.	52	?	Appendicitis		+	—	—	—	Not relieved by appendectomy
7. Hirschman <sup>15</sup>	1932	M.	18	9 yrs.	Ulcerative colitis	Loss of weight	+	—	12 in. of thick- ened ileum	Granuloma	Well 9 yrs. later.
8. Gordon <sup>12</sup>	1933	F.	49	3 yrs. chronic appendicitis, 1 yr. later tu- mor appeared			+	—	Ileocecal region 1 yr. later	Granuloma	
9. Hanford <sup>16</sup>	1933	F.	30	?	Tumor (cramps)		—	—	Terminal ileum	Granuloma	Symptoms contin- ued
10. Janssen <sup>17</sup>	1933	F.	21	2 wks.	Acute appen- dicitis		+	—	—	?	Fistula developed
11. Eggers <sup>18</sup>	1933	?	57	1 yr.	Obstruction		—	Roentgen- ray treatment	—	—	Well 2½ yrs. later
12. Eggers <sup>18</sup>	1933	?	64	35 yrs.	Chronic ap- pendicitis	Mass r. l. q.	—	+	Explor. 1 mo. later. Mass much smaller, not removed	—	Well 9 mos. later
13. Peterson <sup>14</sup>	1933	?	?	?	Chronic chole- cystitis, 7 mos. later obstruc- tion, ? malign- ant, roent- gen-ray therapy		+	+	6 mos. later well for 5 yrs., then abscess drained	—	Sinus persists

# GRANULOMA OF ILEOCECAL REGION

14. Rocky <sup>19</sup>	1933	M.	5	2 yrs.	Acute appendicitis	Temperature, r. l. q. Distention	+ Normal appendix thickened	-	-	Convalescence normal
15. Rocky <sup>10</sup>	1933	F.	9	2 yrs.	Acute appendicitis	Tenderness r. l. q.	+ Term. ileum thickened	-	Normal appendix	Recovery
16. Rocky <sup>10</sup>	1933	M.	11	1 wk.	Acute appendicitis	Tenderness r. l. q.	+ Term. ileum thickened	-	Normal appendix	Recovery
17. Rocky <sup>10</sup>	1933	F.	19	3 days	Acute appendicitis	Slight tenderness r. l. q.	+ Terminal ileum thickened	-	-	Recovery
18. Homans <sup>7</sup>	1933	M.	30	6 yrs.	Tb. ?	Roentgen-ray. Narrow ileum. Loss of weight.	-	+	Cecum and 40 cm. ileum	Recurrence. Roentgen-ray, ileum still involved
19. Homans <sup>7</sup>	1933	F.	26	2 yrs.	Tb. ?	Loss of weight. Mass r. l. q. Roentgen-ray, ileum narrowed	-	+	Ascending colon and lower ileum	Gained 30 lbs. Diarrhea, ? functional
20. Clute <sup>8</sup>	1933	M.	40	1 yr.	Ileitis ? Perforation ?	Tender spasm r. l. q.	12 yrs. before	+	-	Partial relief
21. Clute <sup>8</sup>	1933	M.	41	3 yrs.	Chronic obstruction	Weight loss. Roentgen-ray, constriction at cecum	-	+	-	Gained 25 lbs. in 3 months. Relieved
22. Phillips <sup>13</sup>	1934	M.	25	5 yrs.	Obstruction	Tender l. l. q.	1 yr. before	+	Cecum and lower ileum. End-to-end anastomosis	Fistula 1 yr. later. Ileotransverse colostomy. Relief
23. Bell <sup>19</sup>	1934	F.	28	4 yrs.	Obstruction lower ileum	Roentgen-ray positive	6 yrs. before	+	+	Chronic cicatrizing enteritis
24. Holman <sup>10</sup>	1934	M.	6	24 hrs.	Appendicitis		-	+	Cecum and lower ileum	Recovery
25. Binney	1935	M.	19	3 wks.	Postoperative fistula	Discharging sinus of abdomen	3 yrs. before	+	Ileocecal	Recovery
26. Binney	1935	F.	19	1 yr.	Chronic obstruction. ? Tb. cecum	Mass at cecum	6 mos. before	+	14 mos. later, ileocecal region	Good convalescence

*Diagnosis.*—Even a superficial glance at the published case reports affords sufficient explanation for failure to make a correct diagnosis on history and physical findings. Naturally few of the earlier observers knew anything of the pathology of this disease: and often the diagnosis was unsuspected until resection for supposed tuberculosis or neoplasm was carried out, and the true diagnosis was made by the microscope.

In a few instances during the past three or four years the diagnosis has been suspected by the surgeon (Clute,<sup>8</sup> Homans) with the aid of a roentgenologic examination. The close similarity to other lesions makes an exact diagnosis exceedingly difficult if not impossible. Tuberculosis of the hyperplastic type probably is more often confused with non-specific granuloma in this region than other conditions, such as carcinoma, sarcoma, or syphilis leading to tumor formation. The use of the roentgen ray may be precluded in cases of the acute appendicitis type or where vomiting is present. Its value, however, in selected cases is well brought out by Kantor<sup>9</sup> who, in 1934, reported on a study from the roentgenologic standpoint, of six cases operated upon by Dr. A. A. Berg. In these, his findings were:

- (1) A constant filling defect in the lower ileum.
- (2) In 50 per cent the small intestine showed abnormal shape of the loops proximal to the filling defect.
- (3) Actual obstruction in some cases (here 30 per cent) causing retention of the barium meal in the ileum nine or more hours after administration and dilatation of proximal loops.
- (4) The "string sign," a thin, irregular linear shadow suggesting a cotton string in appearance and extending more or less continuously through the entire filling defect and ending at the ileocecal valve. This is the most striking filling defect and was present in four of the six cases. This, however, does not exclude tuberculosis, syphilis or sarcoma.

He emphasizes the importance of frequent films, every hour or so, after administration, to avoid missing the passage of the barium meal through the constricted portion. In his series, the diagnosis was made before operation in one case only. The possibility of preoperative diagnosis will depend upon the stage in which the patient is seen, as indicated by the four clinical picture groups outlined above. In the first group, when acute appendicitis may be closely simulated, the roentgen ray will usually be inapplicable on account of nausea and vomiting. Here the diagnosis can be made only after the disease is exposed at operation. In the other groups, the roentgenologic technic suggested by Kantor may help to suggest the strong possibility of regional ileitis, especially in cases which present a history of repeated attacks over a period too long for the relatively short course of tuberculosis or malignant disease. Where the disease is of the chronic ulcerative type, the absence of free blood in the stools, as emphasized by Homans, is of importance.

*Prognosis.*—Of this collected series of 26 cases, but one patient died following operation. This was Dalziel's case, in which exploration only was performed on account of a very extensive process producing signs of chronic

obstruction. A study of the group resembling appendicitis shows that many of those in which appendectomy only is done will have further symptoms. Crohn, Ginzburg and Oppenheimer found that 50 per cent of the cases observed by them had been previously subjected to appendectomy. In the collected series here studied, eight cases had had no further operative treatment at the time of reporting. Four of these reported by Rockey<sup>10</sup> have not been followed long enough since operation to be considered cured. Of the remaining four, one (Friedenwald<sup>11</sup>) was unrelieved and symptoms were continuing at the end of two years. The other three, (Moschowitz and Wilensky, Gordon,<sup>12</sup> Phillips<sup>13</sup>) showed recurrence of symptoms in from five months to two years. From this series, therefore, one cannot deduce that appendectomy alone is ever followed by permanent cure, nor is there any suggestion from a study of the pathology that such a result can be expected. The other 18 cases of the series, which had had previous appendectomy without permanent relief, were subjected to the following operations and showed results, as follows:

*Drainage of Abscess.*—One case (Clute). Improved.

*Ileocolostomy.*—(Side-tracking.) Three cases (Friedenwald, two), (Clute, one). Recovery.

*Resection and Ileocolostomy.*—Fourteen cases, in one of which the late result is not known. In two (Moschowitz and Peterson<sup>14</sup>) fistulae developed. In one (Homans) the patient improved, and in another (Homans) there was recurrence in ileum. In the remaining ten cases "recovery" or "well" after periods from six months to two and one-half years, was noted.

Summing up the results in the whole series, one may say that the mortality in this disease is low (less than 4 per cent) considering that operations of considerable gravity may be necessary to effect a cure: that appendectomy probably influences the course of the disease but little; that ileocolostomy alone may be followed by permanent relief in some cases, but as yet this is sub judice and that radical removal of the diseased intestine gives the best chance of permanent cure (71 per cent in this series).

*Treatment.*—The fact that many of the cases in this series had been given more or less prolonged medical treatment without lasting benefit indicates that surgery is necessary to effect a cure in all cases. This conclusion must be qualified, however, by the statement that Eggers found one of his cases benefited by roentgen ray therapy following a side-tracking operation only. Peterson also had a similar experience, the improvement lasting for five years. Both cases later came to further operation so that how much importance can be given to the roentgen ray therapy rather than the ileocolostomy is a question. It is probably fair to say that in selected relatively early cases, this method of treatment should be given further trial. As to the precise operative procedure to be chosen, it is apparent that although ileocolostomy alone had been followed by temporary benefit, it cannot be expected to effect a cure in any large proportion of cases. In cases compli-

cated by abscess or fistula, or in patients whose general condition does not warrant radical treatment, it may prove of great temporary value. This certainly was true in our second case.

Resection of the diseased bowel has been more effective in producing a cure than any other procedure, and must be regarded as the operation of choice in the large majority of cases. While a side-to-side anastomosis, either previously or at the time of resection, has been employed in most cases, in our first case we obtained a good result by an end-to-end anastomosis between the dilated end of the ileum and the ascending colon.

#### CASE REPORTS

CASE I.—Joseph H., aged 19, was admitted to the Boston City Hospital, First Surgical Service, January 25, 1934, complaining of a tenderness in the region of an appendectomy scar.

*Previous History.*—Whooping cough as a child. Tonsillectomy at eleven years of age; otherwise healthy, good appetite, bowels regular. About five years ago had a sudden attack of abdominal pain, below the umbilicus, somewhat relieved after vomiting. Next day was admitted to the hospital, where symptoms recurred to a milder degree. There had been a similar mild attack six months before. Temperature, 100°; white blood cells, 7,200; polymorphonuclears, 82 per cent.

*Physical Examination.*—Negative except for tenderness in right lower quadrant and several small "olive-like" masses palpable in this region on deep pressure. No spasm. Symptoms subsided and patient was discharged four days later with diagnosis of sub-acute appendicitis and "tabes mesenterica."

Five weeks later had an attack of right lower quadrant pain, with vomiting. Pain was of colicky nature—every 15 to 20 minutes—lasting one to two minutes. After two days, pain less severe. After a week readmitted. Tender over appendix region. Next day appendectomy under local anesthesia. Some free fluid present. Appendix retrocecal and bound down by adhesions to cecum in proximal half. Wound closed. Kahn negative. Pathologic report: Healed appendicitis. Normal convalescence. Discharged on eleventh day.

About a month after the appendectomy he began to have cramp-like pains in the lower abdomen, worse in right lower quadrant. During attacks he felt a lump in this region which became tender. Usually he felt better after bowels moved. Bowels fairly regular. Pain aggravated by cathartics. As attacks increased in severity, he was again admitted on the medical service for observation (September, 1931). At this time he appeared poorly nourished. P. M. temperature 100° F. Slight tenderness and spasm noted in right lower quadrant. Nauseated at times. Examination of chest showed diminished resonance at left apex: no râles. Roentgenologic examination showed moderate infiltration of left apical region. Sputum negative for tuberculosis. As some rigidity of spine was noticed, roentgenograms were taken which were reported as tuberculosis of eleventh and twelfth dorsal vertebrae. Stools negative for T. B. and for occult blood. Barium enema negative, but "cecum is tender." At this time he had lost about 15 pounds in weight. Was discharged to a tuberculosis sanitarium in October, 1931, where he received palliative treatment, rest in bed and heliotherapy. He improved, gaining in weight, finally resuming an active life and was discharged "arrested" in February, 1933.

At time of admission to our service (January, 1934), he stated that for past three years occasional sharp pains in region of scar, lasting a few minutes, have continued. Gained weight in past two years, good appetite and bowels regular. Recently noticed a swelling in region of scar, painful and tender for past two days. Examination showed a



reddened, fluctuant mass in this region, two inches in diameter, very tender on pressure. Temperature, 99° F. Urine negative. The abscess was incised and drained. Discharged two days later to out patient department. Two weeks later the discharge became fecal and he was readmitted February 15, 1934. At this time impaired resonance of left lung apex and slight lower dorsal kyphosis noted. Mass in region of scar with fistula in center. Diagnosis.—Tuberculosis (?), regional ileitis (?).

Cultures from fistula showed *B. Coli*, diphtheroids, *Staphylococcus aureus* and *Streptococcus viridans*.

As the fistula showed no tendency to close, he reentered the hospital and on April 1, 1934, under spinal anesthesia, tract of fistula excised down to the cecum and cecal opening closed, but it soon reopened. Patient again left the hospital with the fistula discharging, but was readmitted October 29, 1934, a second fistula having developed. Painful attacks apparently less severe during past year. The diagnosis was now probable tuberculosis of the cecum and radical operation was advised and accepted. On November 7, 1934, under gas-oxygen anesthesia, the fistulae were packed with gauze and an incision six inches in length, avoiding the fistulae, was made and cecum developed by dividing adhesions. In the process the cecum was opened, the wall being very thin in places, elsewhere much thickened, especially about the ileocecal valve. Cecum packed with gauze and lower ileum freed, found pale in color, markedly distended and wall moderately thickened. The condition was recognized by my assistant, Dr. Joseph Tartakoff, as regional, (terminal) ileitis. Resection of the ileocecal region, five inches of colon and two inches of the ileum, was carried out, and owing to the dilated condition of the ileum, end-to-end anastomosis in two layers performed. Owing to the bowel having been opened, a cigarette wick was placed into the pelvis and wound closed about it. Patient made a good recovery, drain being removed on the seventh day. Discharged on the fifteenth day. Bowels moving normally. The patient has had no further trouble to date.

*Pathologic Report.*—Joseph H., S-34-3838. *Gross.*—Specimen consists of two masses of tissue, one measuring 4 by 2 by 1 cm., covered on one narrow surface by skin which has several ulcerated areas 2-3 Mm. in diameter. Subcutaneous tissue is reddish-gray and firm. Cut surface shows sinus tract through subcutaneous tissue to ulcerated area in skin. Second mass of tissue measures 14 by 7 by 2 cm. One surface is covered with markedly, injected mucous membrane, from which several pedunculated polyps 1-2 cm. in diameter project. Several ulcerated areas in mucous membrane. Walls markedly thickened. Edges have been cauterized.

*Microscopic.*—*Ileum.* Mucosa.—Considerable portion of mucosa replaced by vascular granulation tissue densely infiltrated with lymphocytes, plasma cells and eosinophiles. Elsewhere the intact mucosa shows some increased connective tissue containing numerous lymphocytes, plasma cells and eosinophiles. Submucosa.—Increased connective tissue beneath granulation tissue described above. This area of connective tissue and adjacent normal submucosa densely infiltrated with the same types of cells as the mucosa. Muscularis.—Numerous lymphocytes, plasma cells and eosinophiles. Serosa.—Increased connective tissue. Focal collections of lymphocytes, plasma cells and eosinophiles. Section from most proximal portion of ileum shows same process as described above but less marked in degree.

*Cecum.*—Mucosa.—Villous-like projections in places. In one area mucosa replaced by granulation tissue thickly infiltrated with lymphocytes and plasma cells. Lymph follicles hyperplastic. Submucosa.—Increased amount of dense fibrous tissue. Foci of many lymphocytes, plasma cells and eosinophiles. Occasional dilated gland filled with mucus. Muscularis.—Some perivascular collections of lymphocytes, plasma cells and a few eosinophiles. Serosa.—Dense fibrous tissue with focal collections of plasma cells, lymphocytes and occasional eosinophiles.

CASE 2.—Gertrude H., an 18 year old school girl, was admitted to the hospital on the Medical Service November 28, 1933, with the following history. The *Family History*

revealed that a sister, now deceased, had been under treatment for supposed pulmonary tuberculosis.\*

*Past History.*—Tonsillectomy at 4 years. Otitis media at eight years. Six years ago was run down and had a cough all winter but no night sweats or hemoptysis. Four years ago, after an attack of pain in back, chills, fever and nausea, the cough returned. Admitted to hospital where fluid was found in left chest posteriorly. Tapped and 1,000 cc. fluid aspirated. Kahn negative. Roentgenologic Report.—“Thickened pleura at left base.” Six weeks later was discharged with diagnosis of tubercular pleurisy to a sanitarium where hilum tuberculosis was diagnosed. An intradermal test was positive. After a stay of ten months she had gained 16 pounds and was discharged for home care. Two years ago she was operated on at another hospital for ischiorectal abscess. She appears to have been in fair health until six months ago when noticed a small, tender lump in the right lower quadrant and was readmitted to the same hospital. The diagnosis was acute appendicitis and operation performed under ether. On exposing the appendix a mass found involving four inches of terminal ileum. Bowel much thickened and edematous. No free fluid. Appendix removed. Wound closed. Normal convalescence. Discharged on eighteenth day with diagnosis of intestinal tuberculosis.

*Present Illness.*—Four months ago again noticed the lump in right lower quadrant. It increased in size and became tender. She began to have attacks of sharp pain in this region and to lose weight. Occasional vomiting and lately, a dull pain, getting worse.

*Physical Examination.*—Temperature, normal; blood pressure, 120/80. A hard, rounded, slightly tender mass, 8 by 8 cm., in right lower quadrant: not adherent to abdominal wall. Can be felt bimanually through the rectum. Urine negative. Kahn negative. Hemoglobin, 65 per cent; white blood cells, 11,000. Tuberculin test positive. Stool negative for tuberculosis. Roentgenologic Examination.—Barium enema shows cecum displaced upwards by mass. Meal showed “cecum and lower ileum irritable and spastic.” Moderate delay at ileocecal region but ileum empty after 24 hours.

*Progress Note.*—In spite of ultraviolet, high vitamin and supportive treatment for some weeks, during which there was no nausea or vomiting and bowels acted normally, the mass continued to increase and painful attacks persisted, with occasional fever. Operation advised with intention of doing a side-tracking operation, supposedly for tuberculosis of cecum. Transferred to First Surgical Service.

On February 10, 1934, under spinal anesthesia supplemented by gas-oxygen, a six

\* The sister's history became known to us after this article was written. There is a striking similarity in the two cases, *viz.*, an illness covering a period of several years, beginning with supposed pulmonary tuberculosis and diagnosed as such by roentgen ray, then fistula or ischiorectal abscess, and finally abdominal symptoms and discovery of mass in region of cecum. The sister's history was, briefly, as follows: At the age of 13 was seen at the out patient department of the Boston City Hospital where fever and dulness in left apex were noted, and roentgenogram showed peribronchial infiltration. Mass in region of cecum noted. Was advised to have home treatment. This was continued for five years when, an extensive fistula in ano having developed, she was operated upon in another city. Several operations were performed during her twentieth year without accomplishing complete healing. During the next year she began to have cramp-like pains and some constipation and finally an acute attack with fever, pain, spasm, tenderness and a mass felt in right lower quadrant. Exploration revealed a tumor of ascending colon, attached to right kidney: considered inoperable, ileocolostomy performed. During the next year, pain and obstructive symptoms occurred off and on and finally in her twenty-second year resection was carried out. She died from shock 12 hours later. At the first operation the appendix was found only slightly thickened and congested. The specimen removed at the second operation was sent to Dr. F. B. Mallory, who found “chronic ulceration; no evidence of tuberculosis.”

inch right rectus incision made over the mass. Peritoneum found much thickened. Incision prolonged upward and peritoneum entered: mass adherent to abdominal wall, size of an orange. In attempting to free it on outer side, pus cavity entered. Yellowish necrotic material escaped, 4 or 5 cc. in amount, apparently tuberculous. Cavity packed. Incision carried around inner side of mass, lower ileum brought up and lateral anastomosis made with transverse colon, with two layers of chromic gut. Wound closed except for small drain into abscess pocket. Material from abscess sent to laboratory where guinea-pig inoculation proved negative. Culture showed mixed growth, including streptococci. Fair convalescence. Fecal discharge developed from sinus to abscess cavity. After six weeks sinus much smaller but still draining. Patient discharged after eight weeks.

After returning home the patient gradually improved in health and was free of painful attacks, bowels moving normally. During rest of 1934 and early months of 1935, in good health save for the discharging sinus. By this time our attention had been called to "regional ileitis" and our probable error in diagnosis realized. Accordingly, when the patient returned for examination early in April, 1935, it was felt that only removal of the ileocecal region would cure the condition. Operation was advised and accepted and the patient reentered the Boston City Hospital April 14, 1935. Two days later, under spinal and gas-oxygen anesthesia, the sinus was isolated. The ileocecal region exposed and about four inches of cecum and ascending colon removed, the ends of bowel closed without drainage. The patient made a good recovery and was discharged two and one-half weeks after operation. She has been well up to the present time.

*Pathologic Report.*—Gertude H. S-35-1107. *Gross.*—Specimen consists of lower ileum and cecum. Entire specimen 21 cm. long, of which 17 cm. is the ileum. Proximal 8 cm. of ileum are only slightly thickened. Mucosa thrown up into many transverse folds. Walls of remainder of ileum average 1 cm. in thickness. The mucosa is thrown up into many folds, is soft and edematous. Slight thickening of muscularis. The ileum within 3 cm. of ileocecal valve and most of cecum has a thick, fibrous, firm, stiff wall. The lumen in this portion is only 8 Mm. in diameter. About 1 cm. proximal to the ileocecal valve is the ostium of a fistula which goes through the wall of the ileum and continues for 1.5 cm., the wall of the latter consisting of fat and fibrous tissue and lined with grayish-red granulation tissue. Portion of cecum inferior to ileocecal valve has its lumen completely obliterated by the thick contracting ligneous fibrous wall. Marked injection of all the mucosa. Entire serosa moderately thickened, grayish-white and granular.

*Microscopic.*—*Proximal Ileum.*—Essentially negative save for hyperplasia of lymphoid tissue.

*Distal Ileum:* Mucosa.—In one area, mucosa is lacking, being replaced by granulation tissue densely infiltrated with lymphocytes and plasma cells. Remaining mucosa contains numerous lymphocytes, plasma cells and eosinophiles. Submucosa.—Numerous lymph follicles, perivascular collections of lymphocytes and plasma cells and diffusely scattered cells of the same type as well as eosinophiles. Connective tissue greatly increased resulting in marked thickening of this layer. Muscularis.—Perivascular collections of lymphocytes and plasma cells. Serosa.—Increased connective tissue. Scattered lymph follicles. Perivascular collections of lymphocytes and plasma cells. Several foreign body giant cells containing crystalline material.

*Cecum.*—Mucosa shows changes similar to those of the distal ileum. Submucosa.—Markedly thickened due to proliferation of connective tissue, formation of lymph follicles and infiltration with lymphocytes, plasma cells and some eosinophiles. At one point, a focal collection of large mononuclears and two giant cells. Muscularis.—Infiltrated with a moderate number of lymphocytes and plasma cells. Serosa.—Increased amount of connective tissue containing both diffusely scattered and focal collections of lymphocytes and plasma cells.

*Colon.*—Negative.

SUMMARY AND CONCLUSIONS

(1) A study of 24 cases reported in the literature, with the addition of two personal cases, is presented.

(2) The present day knowledge as to etiology, pathology and clinical pictures is reviewed.

(3) The prognosis for life is favorable, the mortality in this series being 4 per cent. To effect a cure, radical surgery with or without roentgen ray therapy seems necessary.

(4) Resection of the diseased bowel, either preceded or accompanied by ileocolostomy, is the most effective treatment in the majority of cases.

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## COLECTOMY FOR ADENOMATOSIS AND PSEUDOPOLYPOSIS

A REPORT OF FIVE ADDITIONAL CASES

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IN 1931, at the meeting of the American Surgical Association in San Francisco, I reported six cases in which total ablation of the large bowel and rectum had been done for either familial adenomatosis or complicated chronic ulcerative colitis which had destroyed the bowel functionally, leaving it a focus of infection besides producing other unpleasant sequelae.

To this report I now wish to add five cases which I have operated upon during the past three years, in three of which extirpation of the colon was done for the familial variety of adenomatosis, while in the other two the secondary indication of ulcerative colitis necessitated surgery.

In the two series, the entire colon and rectum was sacrificed in seven cases, while in four the whole colon was removed, leaving the rectum. In two of these cases the rectum was saved by a deliberately planned procedure with the idea of destroying the polypi and subsequently reestablishing the continuity of the gastro-intestinal tract by an anastomosis between the terminal ileum and the rectal stump. This was accomplished successfully in one case, but in the other case an operative mortality following the colectomy prevented the carrying out of the planned procedure.

In the other two cases in which operation was done for chronic ulcerative colitis, the rectum was not excised, but I assume that there is a strong possibility that this may be necessary at a subsequent stage, although at present the health of the two individuals is extremely good and they have resumed their usual occupations.

The question of saving the rectum and destroying the polypi, thus obviating the sacrifice of the sphincteric mechanism and the permanent use of an ileostomy, seems to be favorably answered for certain cases by the result not only in the case successfully treated by this method, but in the response to fulguration of the other case in which it was tried but which terminated fatally following the second stage of the operation.

Hitherto, I have felt that because of the possibility of malignancy developing in the disseminated adenomata, one should routinely employ the extremely radical procedure, and in the first six cases which I reported this was done. However, after observing the gratifying response to fulguration in the rectal stump, particularly after the fecal stream has been side-tracked, I feel certain that many of these cases may be treated by this alternative method, and successfully so. Of course, in the chronic ulcerative colitis variety where a "lead-pipe" colon, the result of long-standing inflammatory changes, is removed, there is no question of anastomosing the small bowel into



the rectal stump, and the ileostomy must be borne permanently. The question of whether the rectum is removed at a subsequent stage depends upon whatever complications develop such as perirectal abscesses, *etc.*

*Indications and Pathology.*—Most observers agree that in about 50 per cent of the cases of diffuse adenomatosis of the familial type, carcinoma develops if the lesion is left unremoved or undestroyed. Certainly, that there is a distinct relationship between cancer and benign diffuse adenomatosis, cannot be denied.

Cuthbert Dukes of St. Mark's Hospital, London, England, has an interesting and carefully compiled series of families in which several members in different generations have developed multiple polypi, and his paper on "The Hereditary Factor in Polyposis Intestini, or Multiple Adenomata," published in the April, 1930, issue of the Cancer Review, is a most instructive one. He points out first, that "these polypoid growths are composed of adenomatous proliferations of the intestinal mucosa"; second, that "they are the result of an inherited constitutional predisposition to epithelial tumors of the intestine"; third, that "the disease runs in certain families, being inherited as a Mendelian dominant"; and fourth, that "it almost invariably ends in cancer of the intestine."

Hitherto intestinal polypi have been described under many different terms, most frequently being designated as "multiple polyposis." Pathologically, one must distinguish between the congenital or disseminated type and the pseudopolyposis secondary to inflammatory ailments of the large bowel.

In studying the histopathology of adenomatosis and the relationship to malignancy some years ago, FitzGibbon and I, in tracing a series of cases from hyperplasia of the polypoid type of growth to malignant change, used much the same criteria as Wechselmann, Schmieden, and others in studying not only the epithelial elements of the tumor, but the connective tissue framework and macroscopic appearances as well.

That polypi may be divided into three distinct groups, varying grossly and microscopically, is, I think, an easily reached conclusion. In Group 1, the epithelial elements are normal; the tumors appear as small nodules on the mucous membrane of the bowel sometimes as large in diameter as 2 cm. on gross section, and are invariably pedunculated. We do not believe that this Group 1 polyp has a tendency to become malignant, although the possibility must be admitted.

In the Group 2 polypi the changes in both the epithelial and connective tissue elements are quite pronounced and obvious. Not only does the epithelium fail to differentiate into normal mucosa, but the cells are elongated, arranged in single rows, and occasionally pushed into buds which project into the tubules or the connective tissue matrix. The nuclei are elongated likewise, and take stains deeply, giving to the proliferating tissue a darker color.

With continuation of the proliferation of the epithelial elements, a complementary response in the connective tissues of the muscular coats results in the formation of a pedicle which will be large or small according to the

rapidity of growth. Most likely this rate of development is an important factor in the sequence of changes from benignancy to malignancy. These polypi of Group 2 may attain great size and by the very action of the intestinal peristalsis be either pushed along the lumen of the bowel, producing an intussusception, or even be amputated from their stalks and extruded through the rectum. The carcinomata which develop from such polypi usually are the large pedunculated adenoid-like intraluminary growths which are of low grade malignancy as measured by Broders' index, whereas the polypi of Group 3 which represent but an accentuated form of Group 2 develop much more rapidly, become punched out, sessile, ulcerating carcinomata which invade the bowel toward its serosa rather than toward the lumen.

This is an important clinical point because it may be demonstrated that the rectal and colonic growths which project intraluminary are usually less malignant, and that the sessile, ulcerating, rapidly growing ones progress toward the serosa and therefore invade the adjacent lymphatics more quickly. The very fact that it is provable that polypi, either single or multiple, or widely disseminated in form, do metamorphose into malignancy, and further, that this malignancy occurs more frequently in that segment of the bowel in which polypi occur more frequently, namely, the lower sigmoid and rectum, influences one to accept them as etiologic factors in a high percentage of cancers of the colon and rectum. That it is impossible to state how high a percentage or defend the theory that all cancers of this location develop on polypi, is obvious, nevertheless, it is difficult to escape the conclusion that such a theory is most tenable generally.

The congenital type of polypoidosis manifests itself by the well-recognized symptomatology of profuse rectal hemorrhage, diarrhea, and anemia in young people, and can be easily differentiated from the pseudopolyposis of inflammatory lesions, although the latter sometime even develop malignancy as Bargaen showed in reporting 25 cases of carcinoma which had developed in the presence of polypi secondary to inflammatory lesions in a series of 1,100 cases of ulcerative colitis.

This latter type—pseudopolyposis—constitutes the second very definite indication for removal of the colon when that organ becomes not only functionless, but distinctly dangerous as a source of absorption.

In the one instance—adenomatosis—the patient is faced not only with a debilitating disease which during exacerbations greatly undermines health, but with the certainty that at least one-half of these cases die of cancer.

In the other type of lesion, a fulminating acute disease finally is improved by therapy which includes an ileostomy because of the nature of the underlying pathology and if there result unfortunate sequelae which produce arthritis or other debilitating conditions, ample reason for undertaking a series of grave operative procedures is provided.

The appended five cases illustrate not only the pathologic types for which operation was done, but the complications which may occur during and following operation, and furnish also additional proof that by the use of ful-

guration for the destruction of polypi in the lower segment of the bowel, it is possible to extirpate those portions of the colon which may not be so treated, and thus in addition to removing the menace of malignancy, save nature's splendid sphincteric apparatus and obviate the necessity of permanent abdominal stoma.

#### CASE REPORTS

CASE 7.—A. D., female, aged 19, first examined October, 1932. Family History: Father, one sister, three brothers, living and well, and no significant bowel history in any member of the family. Menstrual history is negative; menses began at 13, three days' duration, no discomfort, usual 28-day type. Past History: No serious illnesses—had the usual diseases of childhood.

*Chief Complaint.*—Bleeding from the bowel which began when the patient was five years of age. At that time it was discovered that she had rectal polypi which tended to

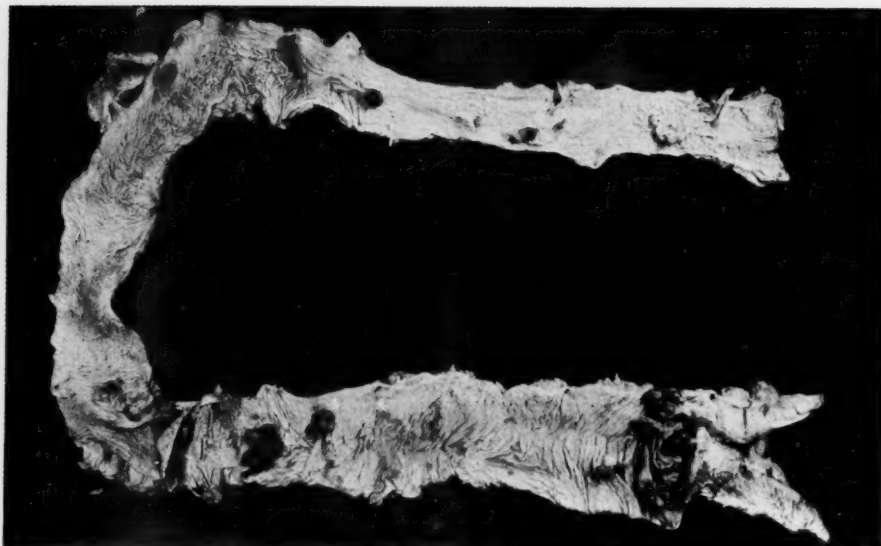


FIG. 1.—Case 7.—Entire colon and rectum showing multiple pedunculated polypi and numerous smaller ones throughout the entire course of the bowel. There are several very large polypi in the cecum.

bleed and protrude, and which were excised on nine different occasions by her local physician without any change in her symptomatology. She suffered from constipation, Grade 3, which was relieved by daily administration of mineral oil. She frequently had low abdominal cramps, and more frequently passed bright red blood, and between such attacks often noticed blood on the stools.

Her general health was not impaired and she has maintained her average weight. Roentgenologic examination following barium enema showed multiple polypi involving the entire colon. On October 14, 1932, she was operated upon through a McBurney incision, a single barreled ileostomy being made. Multiple polypi could be felt in the cecum. Her recovery following the ileostomy was satisfactory and she gained weight and strength and had no complaint except for an occasional bloody rectal discharge. When she returned in March of 1933, six months later, for the colectomy, she weighed 133 pounds which was an increase of 10 pounds over her usual weight, and her general examination was negative. The rectal examination still showed many polypi extending up as far as the finger or proctoscope could reach.

The blood count was: erythrocytes, 4,000,000; hemoglobin, 76 per cent; and leuko-

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cytes, 8,200 with 62 per cent polymorphonuclear neutrophils, all of which were segmented. There were 33 per cent lymphocytes; 3 per cent monocytes; and 2 per cent eosinophiles. The urine was negative. Roentgenologic examination of the colon was not done.

At the time of the second stage of the operation the following was done: long left Lennander incision. Colon was mobilized easily from right to left, and a subtotal colectomy was done, removing the organ down to the lower third of the sigmoid (Fig. 1). The omentum was saved, the raw surfaces were easily peritonealized. It was determined to do a combined perineo-abdominal resection, removing the lower segment of the bowel and rectum at a subsequent stage.

Following this second stage, the patient's immediate postoperative condition was satisfactory. She received a routine transfusion of 500 cc. of citrated blood on the first postoperative day. The maximum temperature was 100° the first seven days postoperatively, while the pulse did not exceed 100. The convalescence was uneventful and she was dismissed from the hospital on the fourteenth day, her wounds being healed and her general strength sufficient to allow her to walk out of the hospital.

Three months later she returned for a check up, saying that she had been doing unusually well until the past three weeks when she began to feel general malaise, the ileostomy did not function satisfactorily over this period, and she suffered generalized abdominal pains with occasional nausea and vomiting. This was relieved by treatment and she remained free of pain for a while, but the ileostomy did not function as well as previously. A general check up on her showed the blood count to be: erythrocytes, 4,590,000; hemoglobin, 76 per cent; and leukocytes, 7,000. The urine was negative. The general physical examination was negative; the examination of the ileostomy showed a reduction in caliber of the opening due to scar tissue contraction, and it seemed to me that this was the source of the patient's obstructive symptoms.

The ileostomy was dilated manually, the scar tissue excised around the opening, and she was dismissed from the hospital on the third day with instructions to continue dilation of the ileostomy with her finger.

After an interval of three months she returned for the third stage of the operation, namely, the combined perineo-abdominal resection of the rectum. Since her last visit it had been necessary to dilate the ileostomy daily and the cramps in the abdomen had continued at intervals of two or more weeks, at which times they would last from two to three days at a time. She had continued on liquids and soft diet, but with no abatement of the distress.

General examination at this time gave no evidence of any findings different from those of previous visits. After preliminary preparatory treatment over a period of five days, a combined perineo-abdominal resection was done. Her convalescence was uneventful. She remained in the hospital for 18 days, at the end of which time she was dismissed in good condition.

One year later the patient reported that for a period of ten months she had had the same generalized cramps in her abdomen which she had previously complained of, and which were still relieved by passages from the ileostomy. The attacks, however, had grown more frequent and the present illness had lasted two weeks. Some nausea and vomiting were associated with these attacks which had not been present during the others. When she returned, the examination was essentially negative, but the attacks were so definitely obstructive in type and had persisted over such a period of time that it was felt necessary to make an exploration of the abdomen. This was done through a long left rectus incision and an obstructing band in the jejunum was found. The bowel proximal to it was distended three to four times its normal size. This band was divided and the obstruction immediately relieved.

It was interesting to note that the abdomen was remarkably free from adhesions with the exception of the one very definite string-like band which accounted for the patient's obstruction.

The immediate postoperative course following this procedure was uneventful and smooth. There was immediate relief of all the previous discomfort and the ileostomy functioned without interruption. The patient was dismissed from the hospital on April 12, 1934. Since that time she has remained well, is back to normal weight and engages in her usual occupation.

*Comment.*—The unusual opportunity to explore this abdomen 12 months after the final operation—the combined perineo-abdominal resection which completed the total colectomy—revealed the almost complete absence of adhesions in the abdomen despite the extensive surgical procedures which had been undertaken in multiple stages. A single obstructing band was the sole

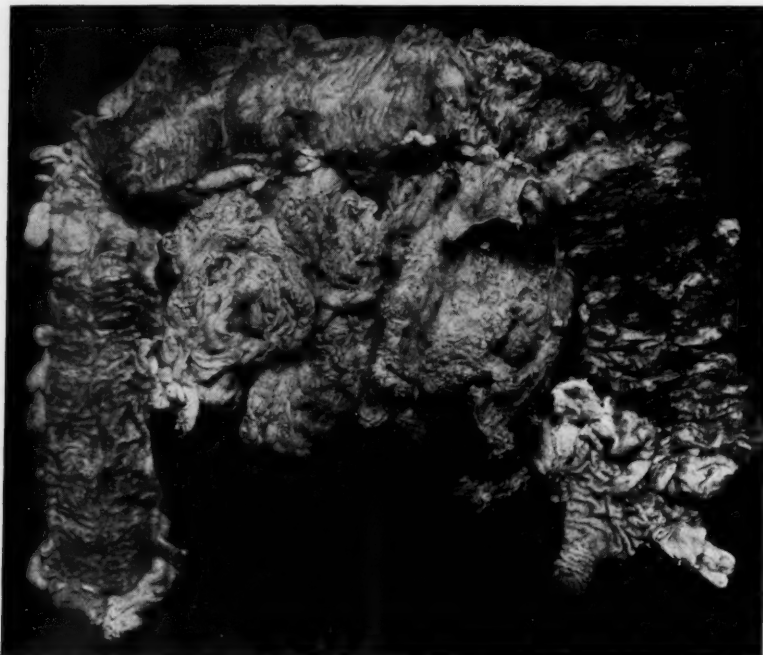


FIG. 2.—Case 8.—This picture shows the entire colon which was removed with the omentum. The rectum was preserved and in this case the continuity of the gastrointestinal tract was reestablished subsequently. The polypi are diffuse throughout the entire colon, but are small.

evidence of inflammatory reaction which had followed these operations. The rest of the peritoneal cavity appeared as though the large bowel were congenitally absent.

CASE 8.—Mrs. T. J. R., female, 32 years of age, married, whose past history is not unusual except for puerperal sepsis with her first child born in 1921. The family history is significant in that her mother died at the age of 32 with polyposis of the colon.

Patient was first examined on June 9, 1932, because of a complaint of severe headaches at the time of her menses, and irregularly occurring gaseous distention of the upper abdomen, relieved usually by soda. There was no quantitative food distress, no heart burns, no sour stomach. Her bowels were inclined to be loose and there had been one spell of diarrhea lasting several days at the onset of this discomfort several years ago, but no history of blood in the stool was obtained.



## ADENOMATOSIS AND PSEUDOPOLYPOSIS

On examination patient appeared fairly well nourished and developed, 5 ft., 4 inches tall, and weighing 123 pounds. The systemic examination was essentially negative with the exception of bowel irregularity which on closer inquiry seemed to have a considerable bearing on the patient's major distress. Proctoscopic examination, however, showed multiple polypi in the rectum and rectosigmoid, while roentgenograms of the colon following barium enema revealed that these polypi extended throughout the large bowel, although more prominent in the left half. Surgery was recommended and on June 24, 1932, a single barreled ileostomy was made. Her recovery was uneventful and on October 7, 1932, subtotal colectomy was done, removing the large bowel down to the juncture of the middle and lower third of the sigmoid (Fig. 2). It was deliberately planned at this time, because the polypi were not so diffuse as had been seen in other cases, to attempt fulguration of the lower segment and if this was successful, to reestablish the continuity of the gastro-intestinal tract.

The patient's postoperative convalescence was uneventful and following fulguration she returned in September of 1933 when proctoscopic examination revealed that the entire rectum was clear of any polypi. On September 29, 1933, one of my former colleagues again operated upon her, doing a lateral anastomosis between the terminal ileum and the rectosigmoidal segment. She was dismissed on November 8, 1933, in excellent condition and her most recent report in February of 1935 states that her general health is excellent with no restriction in activity and that she quite easily performs her household duties, indulges in swimming and other sports without the slightest fatigue or discomfort. Her bowels have been restored to normal routine, without distress. Her weight is 123 pounds, which represents her optimum weight.

*Comment.*—The maneuvers carried out in this case, resulting in the ablation of the colon and the reestablishment of the continuity of the gastro-intestinal tract, represent the ideal surgical offensive in handling a case of diffuse adenomatosis. Certainly, to avoid a permanent stoma, where it may be done without fear of enhancing the chances of developing future malignancy, is greatly to be desired.

The deliberate plan in this case was undertaken because the majority of polypi were beyond the rectosigmoid and yet there was a sufficient number in the rectum to make us feel that unless fulguration rapidly destroyed them, the removal of this segment likewise was justified. The satisfactory disappearance of these tumors under this type of treatment was most gratifying and the final result distinctly satisfactory to both patient and surgeon.

I am convinced that this type of procedure is more applicable than I hitherto believed, and this opinion is buttressed by further experience in Case 10 where the polypi were so diffuse that no normal mucosa could be seen on proctoscopic examination prior to fulguration, but where likewise the response was immediate and most strikingly effective.

CASE 9.—J. D., adult male first examined in January, 1927, at which time he was found to have an extensively ulcerated rectum and secondary strictures suggestive of an advanced although rather localized, chronic, ulcerative colitis. There was an associated rectal incontinence and a secondary anemia, the hemoglobin being 60 per cent, erythrocytes, 3,460,000, and leukocytes, 15,000. The general debility was marked. His chief complaint was of a profuse rectal drainage.

The bowel history dated back to 1920 and was characterized by the irregularities of chronic ulcerative colitis, namely, frequent passages of blood and mucus day and night, varying from 10 to 20 in number and associated with abdominal cramps and generalized

tenderness. He had been treated over a period of seven years symptomatically until this examination and the proctoscopic findings indicated the type of underlying pathology.

On January 26, 1927, an exploration was done and it was found that there was definite ulceration in the lower sigmoid and that the colon above it was somewhat dilated. There was some exudate on the bowel and a colostomy was made at a point several inches above the involved segment. Following this he received the usual serum treatment followed by some vaccine, and had a very good year with marked reduction in his bowel movements and marked general improvement.

On February 18, 1930, he returned and it was found that the disease, as so frequently happens, had spread upward. I did a plastic operation on the colon and made the note that "the ulcerative process has involved the segment of bowel being used as a colostomy and the mucous membrane of this segment is quite thick and edematous. The bowel as far as the finger can reach is evidently involved and I think it will be necessary later to put the colostomy higher in the bowel, or do an ileostomy." On January 5, 1931, I did an ileostomy, making a note that there was a good deal of inflammation around the ileocecal region and suggesting that a colectomy in the future would be necessary.

He made an immediate recovery which was satisfactory and on April 3, 1931, I took out the colon around to the site of the colostomy. This operation was difficult and the specimen removed showed a diffuse ulceration, most marked in the cecum. The operative note is as follows: "An ileostomy and colostomy had been done on this man previously. There is ulcerative colitis that has caused strictures and abscesses. The abdomen is full of adhesions from the former peritonitis. The colon was densely adherent everywhere and I had to dig it out. The operation was extremely difficult. I had approached it through a long left rectus incision and found that where the former colostomy was made there was still a sinus with an abscess in the mesentery and a lot of small bowel adherent. Finally succeeded in getting the small bowel away without opening it and got the sigmoid up, divided it and sewed the end up without turning it in. There was very little peritonealization anywhere. The pelvis was drained with two Penrose drains with gauze, one split tube drain, one rubber tube drain and one strip of iodiform gauze. Think if the patient gets over the shock of the operation, chances of relief of symptoms are good except for the opportunity of developing high intestinal obstruction subsequently."

The patient had a stormy convalescence and was dismissed from the hospital at the end of a month. He continued to have a good deal of drainage from the lower loop and occasional reformation of perirectal abscesses. The original colostomy was a loop one and this gave him some trouble so that on January 19, 1934, a former colleague of mine did an anastomosis between the proximal and distal loops with a Murphy button, leaving him with a single barreled colostomy.

He has been comfortable since this last operation but apparently the adhesions which I predicted at the time of the colostomy have been forming and he has had several attacks of subacute obstruction. These have not necessitated another operation, but unquestionably he continually faces such a dilemma. He has been restored to occupation and at present it carrying on as usual.

*Comment.*—Clinically this patient has had several attacks of incomplete obstruction due to adhesions and in addition has still the lower segment of his bowel which harbors chronic ulcerative colitis. With the occasional development of a perirectal abscess, it is possible that focal infection may come from this later, and I think that it is reasonable to suppose that removal of this remaining segment may subsequently be necessary. He has returned to work, however, and is carrying on his usual duties despite these occasional intermittent interruptions.

## ADENOMATOSIS AND PSEUDOPOLYPOSIS

CASE 10.—Mrs. M. C., aged 28, housewife, whose past history was irrelevant except for the present bowel complaint. Her family history is of interest in that one sister, 24 years old, has adenomatosis of the colon, demonstrated by roentgenologic and proctoscopic examination. One brother died at the age of 25, six days after an operation for the same lesion.

The present complaint is of diarrhea and abdominal cramps dating back eight or ten years, but becoming increasingly worse during the past year. She has bowel movements daily from one to two up to ten or 12, usually loose and frequently containing blood and mucus, but no tarry particles. There has been some soreness over the entire abdomen and particularly in the lower left side, for several years. There is no history of dyspepsia or upper abdominal distress.

Systemic history of the head and neck, cardiorespiratory, genito-urinary, and nervous systems was without significance. The patient is a well nourished young female 5 ft., 2 inches tall, weighing 122 pounds, whose blood pressure is 104/70, pulse 80, and temperature 98.6°. Head and neck show nothing unusual except for a small adenoma one centimeter in diameter in the upper left pole of the thyroid. There are no tremors of the tongue or extended fingers, and no eye changes. The lungs are clear throughout, the breasts are nulliparous in type, and contain no tumors or abnormalities. The heart is not enlarged, the rate being 80 with a regular rhythm. The abdominal examination is not unusual except that there is tenderness and rigidity Grade 2 in the lower left quadrant, and an easily palpable descending colon. Pelvic examination is negative.

Digital examination of the rectum reveals multiple polypi as far as the finger can extend and the proctoscopic examination shows these growths to cover the entire mucosal surface, and to vary in size from a split pea to 1.5 cm. in diameter. The routine blood examination shows: erythrocytes, 3,450,000; hemoglobin, 70 per cent; and leukocytes, 4,500. The urinalysis is negative except for a faint trace of albumin.

On July 5, 1934, a single barreled ileostomy was performed. The whole colon including the cecum was found on palpation to be filled with these polypoid tumors. The convalescence following this operation was without incidence and she was dismissed from the hospital on the fourteenth day to return home for an interval of rest and rehabilitation before the next stage.

Two months after her dismissal, she appeared greatly improved and had gained several pounds in weight. Proctoscopic examination was done and fulguration of the polypi in the rectum was undertaken with the idea that the rectum might be saved and that the reestablishment of the bowel's continuity as in Case 8 might be carried out.

On September 25, 1934, the patient underwent her first fulguration under transsacral procaine anesthesia and the polypi were found to be so thick that it did not seem a favorable case for this type of treatment. However, when she returned two months later, a great recession had taken place in the local process and a further fulguration was undertaken. Following this so much recession occurred that I felt if we could divide the lower colon, remove the large bowel, and thus side-track the fecal current completely and put the rectum at rest, we would have a better chance of accomplishing the proposed procedure.

On November 16, 1934, I removed the whole colon down to the juncture of the middle and lower thirds. It was difficult to turn in the rectal stump satisfactorily because fulguration had not been accomplished as high as the division of the bowel, however, I did get this turned in and covered with fat tags in a manner which I thought probably would be satisfactory. The removed specimen showed a very diffuse adenomatosis throughout the entire colon, more marked in the left half than in the sigmoidal region (Fig. 3).

Following operation a sharp reaction was noted in the first 24 hours, the pulse going to 120 and the temperature to 101°. The routine treatment of the administration of 500 cc. of citrated blood, and fluids given intravenously and by hypodermoclysis to 4,500 cc.

during the first 24 hours, was carried out. The urinary output was adequate. On the third day the temperature had risen to 103° and the pulse to 140. On the sixth day this elevation continued but the patient's general condition appeared better. The abdomen was distended 2 on a scale of 4, and drainage from the ileostomy was free. At this time it was felt that she had a peritonitis.

On the ninth day there was slight change, the leukocytes having attained a level of 31,500 with 88 per cent polymorphonuclear neutrophils, 11 per cent of which were non-segmented. The abdomen was less distended, however, and the patient was taking fluids by mouth without discomfort. The lungs were resonant throughout and the heart, except for the sharp increase in rate, was normal. On the twelfth day her general condition appeared improved—the wound was healed, the dermal sutures were removed, but there was edema low on both sides of the abdomen, the temperature was 104°, and the pulse 130.

Under local anesthesia, a small edematous, indurated area 5 cm. in diameter to the right of and below the lower extremity of the abdominal wound but apparently not associated with it, was incised and a considerable amount of serous, foul smelling, purulent

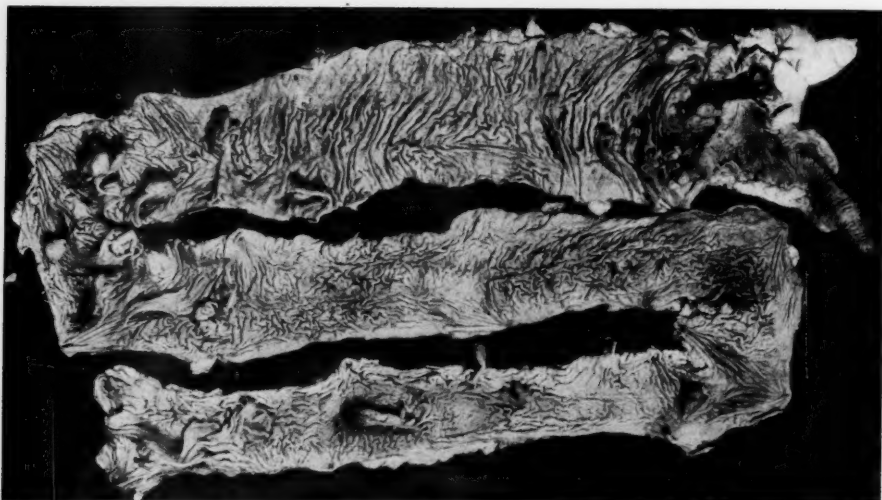


FIG. 3.—Case 10.—Subtotal colectomy was done nearly to the rectosigmoid juncture. This picture shows multiple polypi, some large pedunculated ones and numerous small ones. In the sigmoid and rectum the polypi were so diffuse that no normal mucosa could be seen.

material was liberated. Following this there was some decline in temperature and pulse, and the general condition seemed improved. Vaginal and rectal examinations again revealed no pelvic masses.

On the seventeenth postoperative day another complete examination was made which revealed the chest clear of any consolidations or pneumonic processes. The abdomen was distended 1 plus and there was a moderate amount of purulent drainage issuing from the stab wound at the lower end of the abdominal wound. The ileostomy was functioning adequately.

The general condition of the patient was considered improved and it was felt that she was combating successfully what had evidently been a pelvic peritonitis. At 5:00 o'clock in the afternoon of the eighteenth day the patient complained of severe epigastric pain for the first time, rapidly became cyanotic 3 on a scale of 4, and her radial pulse became imperceptible. The blood pressure fell to 44 millimeters of mercury systolic and 20 diastolic. It was felt that she had a pulmonary embolus. The usual supportive measures were without avail and the patient died within three hours after this attack. A postmortem examination was refused.

## ADENOMATOSIS AND PSEUDOPOLYPOSIS

*Comment.*—Here, I feel, better judgment would have been exercised had I not departed from the customary routine of completing the fulguration before attempting the colectomy. The marked recession of the polypi in many of these cases following simple ileostomy, however, encouraged me in the belief that if the alvine discharges were side-tracked and the lower segment left free to be irrigated for a period and then to be fulgurated until it was clear of polypi, I could hasten the recovery.

Again, a technical difficulty presented itself in the handling of the stump because of the presence of great numbers of polypi. The development of the pelvic abscess and subsequently the pulmonary embolus may fairly, I think, be charged to these changes in procedure.

The astonishing disappearance of the polypi under fulguration was the outstanding point in this case to me and far surpassed any hope I had of such accomplishment. It urges more and more the utility of this method of clearing out a suitable segment for the implantation of the ileum and saving the normal sphincteric mechanism, while at the same time the patient is rid of the potential development of a colonic malignancy.

CASE II.—B. S., male, 24 years of age, whose family history is as follows: father, mother and five sisters living; one of the latter has had chronic ulcerative colitis over the past ten years, during which time she has had a permanent ileostomy and subtotal colectomy. There are no other cases of chronic ulcerative colitis in the family.

Past History: Patient had a tonsillectomy for tonsillitis seven years ago. Present complaint began about that time and was characterized by frequent passages of blood and mucus, and liquid stools as many as 10 to 20 a day. This bowel irregularity was constant, harassing, and accompanied by generalized abdominal cramps. Shortly after onset, the patient became so greatly debilitated and weakened by his constant bowel drainage that he was unable to maintain his normal body weight.

A diagnosis of chronic ulcerative colitis was arrived at, based on proctoscopic evidence, roentgenologic examination of the colon with a barium enema, and cultures made from the ulcers in the rectum. The patient was given vaccine which produced little effect on the bowel lesion. One year after the onset, patient had an ileostomy made. Improvement followed this procedure but the drainage of blood and mucus from the bowel continued. In addition, he was beset by a severe arthritis which involved multiple joints and disabled him for weeks at a time. This malady usually manifested itself more intensely during the winter months and failed to respond to the symptomatic measures in conjunction with baking massage and vaccine therapy. For the past five years the patient has been a semi invalid and unable to perform any type for work. He was first seen by me on January 14, 1935, having been referred for consideration of a total colectomy. This procedure was contemplated primarily to be rid of a grossly and intensely involved colon which continued to debilitate the patient, rendering him an invalid and serving as a focus for his arthritis.

General examination revealed a man 5 ft., 6 inches tall, who weighed only 125 pounds and who appeared chronically ill. His teeth had been roentgenographed and showed no peri-apical infection, his tonsils had been removed, and the sinuses were normal. His heart and lungs were found to be normal. The abdomen was scaphoid and contained in its lower right quadrant an ileostomy. The surrounding skin was not excoriated. The left half of the colon was palpable and tender throughout. There were no abdominal masses present. Rectal examination was difficult and unsatisfactory because of a stricturing inside the anal sphincter, and some fissures which were so painful that only the little finger could be admitted. Proctoscopic examination was impossible, roentgenography of the



colon was not done for the same reasons. There was some slight limitation in the knees, ankles, elbows, and wrists, but no gross deformities and no increased local temperature. The last exacerbation of the arthritis had receded six weeks previously.

The blood count was: erythrocytes, 4,300,000; hemoglobin, 83 per cent; and leukocytes, 17,900 with 83 per cent polymorphonuclear neutrophils, 98 per cent of which were segmented; lymphocytes, 13 per cent; and monocytes, 4 per cent. The urine was negative. The temperature was normal and the pulse was 80.

Following a preliminary preparatory period of five days, during which time the patient was on a high caloric diet and an increased amount of fluids, colectomy was undertaken. His low midline incision was extended beyond the umbilicus through the left rectus muscle up to a point nearly opposite the tip of the ninth rib. The ileostomy had been made close to the cecum and this increased the difficulty of the colectomy which, however, was finally accomplished down to the rectosigmoid juncture in the usual manner. The omentum was saved.

The bowel was friable and jeopardized satisfactory closure of the stump. Precaution was taken against leakage by suturing the stump over and over and by wrapping it in iodoform gauze. He made a satisfactory convalescence, the temperature on the third



FIG. 4.—Case 11.—Typically destroyed colon following long standing ulcerative colitis. Mucosa smooth, haustrations have disappeared, the colon is contracted and functionless.

day reached 102° and the pulse was 120. He had an immediate postoperative transfusion of 500 cc. of blood, and during the first three days fluids were administered intravenously and subcutaneously to an amount of 5,000 cc. daily.

There was considerable purulent drainage from the pelvis which had been anticipated, but this gradually diminished, the drains were removed, and the patient was out of bed on the twenty-first day. Seven days later he was dismissed from the hospital. A recent letter states that he is feeling better than at any time during the past five years and that he has gained 12 pounds within the last month. He plans to return to work shortly after an absence of several years.

*Comment.*—Following ileostomy this patient presented the unusual complication of a "lead-pipe" colon harboring sufficient infection to produce multiple arthritis (Fig. 4). The experience in a former case in this series in which total colectomy was successfully undertaken with complete elimination of arthritis and the return of the patient to work, prompted similar advice to this individual, and the outcome has been equally as satisfactory as in Case 6.

TECHNIC OF COLECTOMY

Like most other operative procedures which remove portions of the colon for different pathologic reasons, total or subtotal colectomy is, I am convinced, best undertaken as a graded operation which may usually be best accomplished in three stages. These stages consist of: first, ileostomy; second, colectomy; and third, either removal of the rectum by a combined perineo-abdominal type of procedure, or anastomosis of the ileum to the rectum and closure at the same time or subsequently of the discharging ileostomy.

Ileostomy should invariably, I think, precede the other technical steps by a matter of weeks or months because of the serious disturbance of fluid balance which is a necessary sequel to it. Large quantities of fluids are discharged through the ileostomy immediately upon its accomplishment, and when one realizes that the right colon where much of the absorption of water takes place normally has been side-tracked, the fluid imbalance which results in dehydration and weight loss, although a serious problem until a physiologic normal has been restored, is not surprising. As time progresses and the ileostomy assumes some of the functions of the large bowel, hypertrophy takes place in its musculature, dilatation accompanies this change, and the stools become semisolid or even formed.

Having once decided to do an ileostomy for adenomatosis or pseudopolyposis it is desirable to construct a single barreled stoma by dividing the ileum close to the ileocecal valve, turning in the cecal end and bringing out the proximal end through a split muscle incision. Formerly, I felt it wise to leave a clamp on this obstructing the end of the bowel for from 36 to 48 hours, but in the recent cases I have been impressed with the advantage of putting a tube into the ileostomy immediately and draining the small bowel from the start. By the use of a mushroom catheter which is held in place by two purse string sutures, leakage is prevented and drainage is advantageously established. It is desirable, after having turned in the cecal end and dropped it back, to shut off the space between the mesentery of the terminal ileum and the lateral parietal peritoneum, thus preventing herniation of loops of small bowel through this aperture, with the development of obstruction.

General abdominal exploration should not be done because in the case of multiple adenomatosis it gives one little information and in the case of chronic ulcerative colitis it is contra-indicated because of the fear of rupturing a concealed perforation, or otherwise damaging the fragile colon to cause leakage and peritonitis.

After the lapse of several months, during which time the patient adjusts his life to the ileostomy and returns somewhat to normal so far as his general condition is concerned, the second stage is performed. Through a long left rectus incision, the colon is removed from right to left. Beginning to mobilize the right colon one cuts the outer leaf of the peritoneum in the blood-

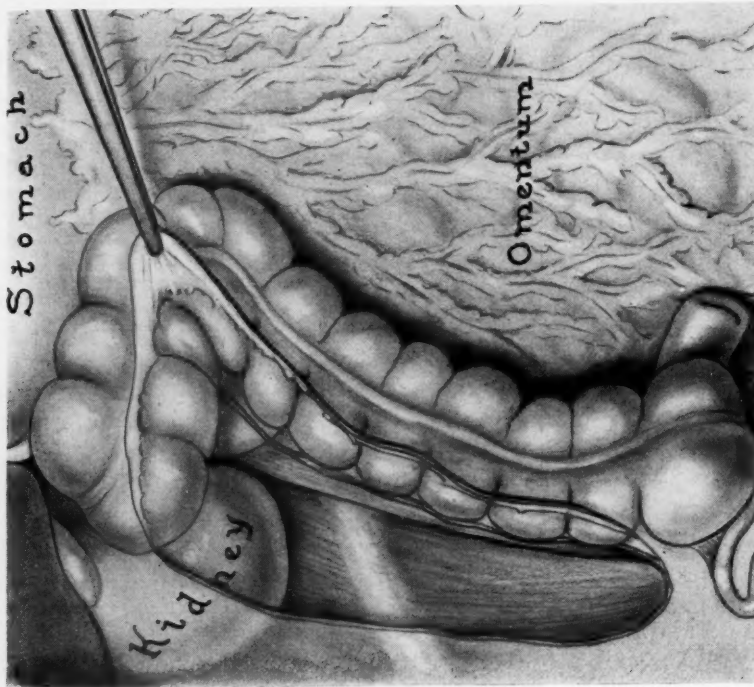


FIG. 5.—The beginning of the mobilization of the colon is shown by dividing the outer leaf of the peritoneum, rotating the colon medially. The blood vessels are ligated close to the colonic wall and peritonealization of this segment up to the hepatic flexure is completed before proceeding further with the mobilization. The omentum is saved usually and in mobilizing the transverse colon it is separated from the large bowel and left attached to the stomach.

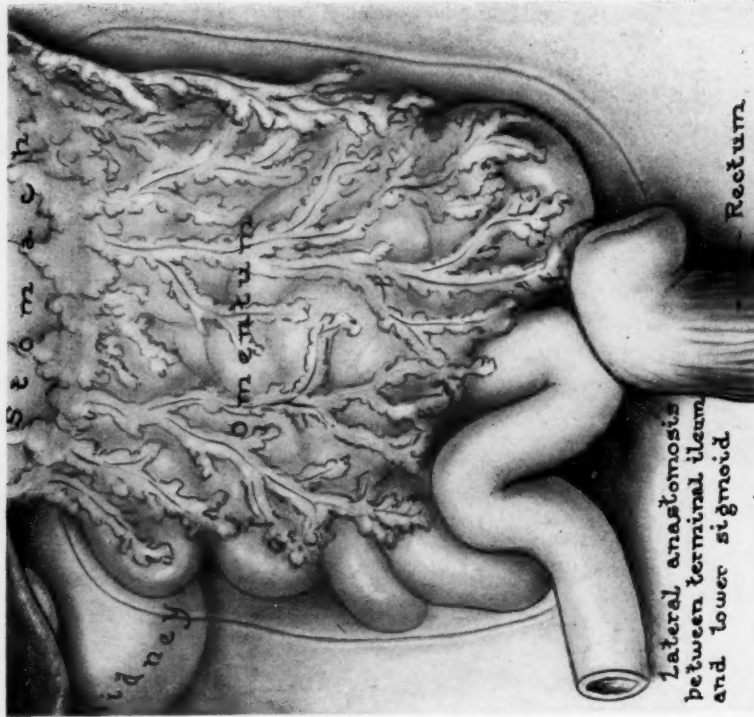


FIG. 6.—Completed operation reestablishing the continuity of the gastrointestinal tract by a lateral anastomosis between the terminal ileum and the lower segment of bowel. The omentum has been saved and covers over the small bowel. The line of peritonealization is shown. The ileostomy is left as a safety valve for a few days following the anastomosis.

less area, rotates the bowel mesially and ligates the blood vessels as they appear, rather close to the bowel wall (Fig. 5). It is not necessary to do a wide dissection like one does in performing a hemicolectomy for malignancy, but by getting rid of the bowel and disturbing the pericolonic tissues as little as possible, the success of the operation is enhanced.

It is helpful to accomplish the peritonealization of raw surfaces as the different segments of the bowel are mobilized. The first mobilization goes up to the hepatic flexure where the retroperitoneal duodenum is identified to safeguard it against injury. When the blood supply to this area has been ligated and divided, the raw surfaces are easily covered over by a running suture, bringing the parietal and visceral layers of the peritoneum together. From the hepatic flexure to the splenic flexure is an easy bit of bowel to mobilize if one leaves the omentum. Let me stress this as an important step! There is no difficulty in separating the omentum from the colon and it is very advantageous to have subsequently as a protection against infection and occasionally as a covering for denuded areas.

The splenic flexure is somewhat hard to mobilize as it lies high and is often adherent, but by cutting the splenocolic ligament and the lateral parietal peritoneum down along the margin of the descending colon, one may rotate it mesially and get at the blood supply accurately. Again, the peritonealization of this segment is accomplished by a running suture adjoining the visceral and parietal layers of the peritoneum, and the dissection is carried on to the lower third of the sigmoid. Here the bowel is cut across and the lower end invaginated, the remaining raw surfaces covered, and the abdomen closed without drainage.

The turning in of the lower end of the bowel is a procedure often fraught with considerable difficulty and danger in either the diffuse adenomatosis cases or in the chronic ulcerative colitis variety. In the former the polypi may be so dense and thick that a crushing clamp will cut through the attenuated and thinned-out wall of the bowel if it is applied vigorously. Certainly, in all chronic ulcerative colitis cases a heavy Payr clamp will cut through if applied at all. Experience in the first colectomy which I did for chronic ulcerative colitis was embarrassing, but enlightening, and subsequently it has been found more desirable to clamp the bowel between two soft gastro-enterostomy clamps covered with rubber, divide it with a cautery, and then suture the lower end over and over, closing it as snugly as possible and turning it in as well as might be. This end of the bowel is then wrapped in a piece of iodoform gauze and the whole surrounded with rubber tissue which is brought out through the abdominal wound.

In the adenomatosis cases it is difficult to turn in the end of the bowel when the polypi are diffuse, but it is not impossible. However, one may find multiple fat tags to suture over the stump, and in a woman, may draw down the uterus and broad ligaments to supply peritoneal covering. Where there is any question of secure closure, it is well to drain as in the case of chronic ulcerative colitis. In the case in this series which succumbed, drainage in

this manner was not established and the resulting pelvic abscess was the indirect cause of death.

The third stage of the operation is advantageously delayed a number of months. If one may successfully fulgurate the rectum and destroy all the polypi, it is not unreasonable to spend a year with the ileostomy before attempting an anastomosis. Perhaps in some cases six months will be ample time, but that likely is the minimum. It is surprising how quickly and readily the polypi, even in the most diffuse cases, will disappear when the fecal current is by-passed and when fulguration is vigorously applied. Should one, however, decide to sacrifice the rectum, as was done in most of these cases, the general condition of the patient after the second stage and the continued employment of rehabilitary measures will decide the optimum time.

At the third stage a combined perineo-abdominal resection is performed after the technic which was described in an article in the November, 1931,

issue of *Surgery, Gynecology, and Obstetrics*. On the other hand, if the rectum has been cleared of polypi and appears relatively normal, an anastomosis between the rectal stump and the terminal ileum may be undertaken. A lateral type of anastomosis between these two segments of bowel perhaps is the most satisfactory and the easiest to accomplish (Fig. 6). It is an advantage to have a safety valve in the form of the ileostomy left for a short while—

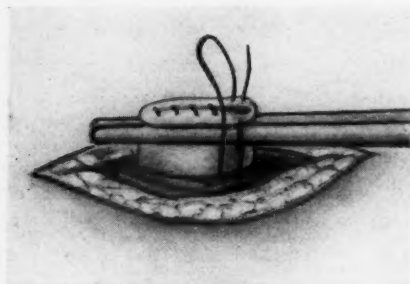


FIG. 7.—Extraperitoneal closure of the ileostomy undertaken a week to ten days following the anastomosis. It is easily accomplished under local anesthesia.

ten days to two weeks—following the anastomosis and this subsequently at another stage, may be easily closed under local anesthesia (Fig. 7).

In the one case in which this graded maneuver was successfully done, preserving the sphincteric mechanism, the outcome to date has been entirely satisfactory and there has been no reappearance of polypi. However, unquestionably one should make frequent proctoscopic examinations of these patients and be constantly on the alert for a return of any polypi.

#### CONCLUSIONS

(1) An additional report of a series of five cases of colectomy for diffuse adenomatosis and complicated chronic ulcerative colitis is offered. Six cases were previously reported in which the entire colon and rectum was removed by multiple procedures, making a total series of 11. In four cases in this report, the colon was removed down to the rectosigmoid juncture; in the other total colectomy was done. In two cases of the chronic ulcerative colitis variety it is probable that the rectum will have to be removed subsequently, although the patients show marked improvement.

(2) In one case the reestablishment of the continuity of the gastro-



intestinal tract was carried out at the third stage following destruction of the rectal polypi by fulguration.

(3) There was one operative death in this series following the second stage colectomy and in this case likewise, fulguration had been carried out on the rectal polypi and the plan was to transplant it subsequently at a third maneuver, into the terminal ileum. The remarkable disappearance of diffuse rectal polypi following vigorous fulguration is surprising and encourages the belief that this plan which has hitherto been considered an alternative one and available only where the rectal polypi were few in number, may be available to a great many more of these cases.

(4) Technical steps of importance are the preservation of the omentum in the chronic ulcerative colitis group and in the case of adenomatosis where there is no suspicion of malignancy. A second technical point of advantage is the method of handling the rectal stump which turns in with difficulty in many of the polyposis cases and not at all in the chronic ulcerative colitis variety. The stump must be closed over as accurately as possible, covered with whatever tissues there are and if there is any question of leakage, wrapped in iodoform gauze and a rubber tissue to establish a drainage track in the event that the suture line fails to hold.

Of these 11 cases, one died 18 months following the complete operation from recurrence of carcinoma which had developed on the polypi and which was diagnosed at exploration. A second case died two years later following a hysterectomy performed elsewhere. One case died in the hospital following the second stage operation, and the remaining eight cases of the series are alive and well and have all returned to their various occupations.

## PEPTIC ULCER AND DISEASES OF THE BILIARY TRACT IN THE SOUTHERN NEGRO

THE INFLUENCE OF DIET

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DURING the ten-year period, 1925-1934, among 60,000 patients (including 15,000 obstetric) admitted to the colored division of the Grady (municipal) Hospital, Atlanta, 119 cases were diagnosed peptic ulcer, and 64 cases were diagnosed as biliary tract disease. During the same period, among 75,000 patients (14,000 obstetric) who entered the white division of the hospital, there were 295 cases of peptic ulcer and 755 cases of biliary tract disease. In other words, in a Southern city of 300,000 population, one-third of whom are Negroes, the incidence of peptic ulcer among white patients admitted to the city hospital was approximately twice as great as among colored patients, while the incidence of diseases of the biliary tract among whites was ten times as great as among Negroes. The percentage of perforated ulcers in the two races was the same, 31 per cent. It has been brought out in a previous paper<sup>1</sup> that in this institution appendicitis is six times more common in white patients than in colored patients.

The comparative rarity of peptic ulcer in the colored race has been noted by other writers, Frank<sup>2</sup> in Kentucky, and Sturtevant and Shapiro<sup>3</sup> in New York. From my impression based on many years' association with the Grady Hospital, I am sure that peptic ulcer is becoming more common among our colored population. Until the above figures were compiled I had no idea that Negroes are subject to the disease as much as half as often as white people. Twenty-five years ago the existence of a gastric or duodenal ulcer in a Negro created a sensation on the wards, while cholecystitis and gallstones were almost unheard of. The ratio of 10 to 1 in gallbladder disease for white as compared to colored patients is more in line with our ideas of the past, although undoubtedly this malady also is being seen more frequently.

What is the reason for the relative scarcity of surgical diseases of the alimentary tract in the colored race, and why are these diseases apparently becoming more general, at least in the South? Undefined racial influences might account to a degree for the smaller number of these cases among Negroes, but the question of diet seems to be a more important element. I became impressed by this fact from the paper of McCarrison on "Faulty Foods in Relation to Gastro-Intestinal Disorder."<sup>4</sup>

In this article McCarrison tells of his surgical experience "in a remote part of the Himalayas where there are located several isolated races far removed from the refinements of civilization . . . races of magnificent physique, pre-

serving until late in life the characters of youth . . . unusually fertile and long lived, and endowed with nervous systems of notable stability."

During nine years' practice among these people McCarrison did not see a single case of gastric or duodenal ulcer, appendicitis, mucous colitis or cancer, although he performed an average of 400 major surgical operations annually. It is not his opinion that such disorders are entirely unknown, but he is positive that they are remarkably uncommon. Diseases of the biliary tract are not mentioned, but most likely come under the same category, although different factors may affect their incidence.

McCarrison believes that the character of food is largely responsible for the absence of such diseases among these tribes, who live on the "unsophisticated foods of nature," such as milk, eggs, grains, fruits, vegetables and very little meat and sugar. Moreover, such foods are produced close to the communities where they are consumed so that it is not necessary to prepare them for preservation and transportation.

How do these articles of diet compare with the foods of civilized man, among whom diseases of the digestive tract are so universal and serious? On account of the crowded conditions of modern life, making the preserving and shipping of food obligatory, our food is polished, sterilized, pickled, canned, frozen, thawed and otherwise treated until its health sustaining ingredients are materially impaired or destroyed. Is it any wonder, then, that we suffer from all kinds of digestive disturbances of which McCarrison's East Indians know nothing?

To disprove what might be claimed, that the paucity of alimentary diseases among these people is due to racial peculiarities, McCarrison had opportunity to observe the health of a large group of one of these races which was compelled to move to another district where their former foods could not be obtained. Immediately many of them developed sicknesses which did not affect them while partaking of their accustomed nutriment. He further proved his contention as to the results of faulty foods in experiments upon wild monkeys made to subsist upon unnatural, artificially prepared diet.

The food of the Southern Negro compares in a measure with that of the natives of the Himalayas. As choice diet Negroes first select fresh green vegetables (turnip greens, collards and cabbage) and a mixed juice made from them, "pot likker." They enjoy other vegetables like "cow-peas," string beans and potatoes, and eat various cereals. Their favorite bread is corn bread, better made from water-ground meal. Fresh fish they love dearly, but similarly to the Himalayans, they do not consume a great amount of meat, except the cheaper kinds of bacon; and are not especially fond of sugar and sweets. Hog meat, particularly "Andy's" pork chops, is their preference, but not generally included in the menu on account of the expense. The same reason applies to chicken. Coffee and tea do not appeal to their appetites, but they relish lemonade, even for breakfast. Milk and eggs are costly and in contrast to the Himalayan custom, such valuable foods do not appear regularly on the table of the Southern Negro.

No matter what rich and delicate viands the colored person as cook or butler may place upon the white folks' table, when he can get it the Negro chooses for himself food as outlined above. It is interesting to observe that, opposed to the rules of dietetic hygiene, he demands his victuals fried and sopped in grease, from which he rarely suffers the pangs of indigestion.

Close inquiry in the homes of the victims of peptic ulcer revealed the fact that the majority of such victims, not all, had strayed away from their natural diet and had indulged in the fare of modern civilization. Some of them worked in homes where they could not obtain the food which agrees with them so well, or they remained away for long periods employed in a store or shop and ate at a lunch counter where the can opener is so freely used. Negroes do not eat canned foods and it is most unusual to find such an article in their homes. Careful investigation was made of this point. As the colored population consumes more unnatural and over treated nutriment, and less of the richly vitamized "pot likker" type, alimentary ailments grow in number among them.

Granted that an important factor in the etiology of the common diseases of the digestive system is faulty food, is it possible to correct it? Could, or would other people be willing to derive their nutrition by such means as described above? I think not. Certainly but little change could be accomplished in a generation. However, thorough study might suggest methods of improving our diet along some of the lines indicated. Social workers, hygienists, public health agents and others could render assistance. McCarrison declares that the East Indian babies are entirely breast fed, or they die. Negroes also seldom resort to any other variety of infant feeding. Here is the place and time for us to begin building resistance against these diseases. Scientifically devised foods often are life-saving, but are not the pediatricians, in spite of their valuable contributions to medicine, too prone to aid and abet modern mothers in substituting artificial nourishment for nature's "unsophisticated" pabulum?

*Peptic Ulcer Statistics.*—Of the 119 cases of peptic ulcer, 91 were in males and 28 in females, the youngest patient being 15 and the oldest 70. Of gastric ulcer there were 46 cases, 18 being perforated; duodenal ulcer, 73, 19 perforated. Hemorrhage occurred in three gastric cases, and in nine duodenal cases.

Twenty-one patients with gastric ulcer were subjected to operation, with six deaths, four of the ulcers having ruptured from six hours to one day previously. Another death resulted from heart complication, and another from excision of the ulcer, all other ulcers being sutured only.

Twenty-three patients with duodenal ulcer were operated upon, with one death, following rupture 30 hours previously. Incision for appendectomy was made in one case which turned out to be duodenal ulcer.

There were 14 deaths among the 75 patients who did not have operation, giving a total mortality of 17 per cent in the 119 patients admitted. Among the 21 patients who were deceased, nine had ruptured ulcers, four not being subjected to operation.

From the high mortality given, it is apparent that many of the patients were received in poor condition, particularly on account of hemorrhage and perforation. Gastro-enterostomy was performed in two gastric cases, with one death from heart complication; excision of ulcer was done in two gastric cases, with one death. Gastro-enterostomy was the operation in nine duodenal cases, with no deaths. Perforation took place in one patient six days before admission, and in another patient two weeks before admission.

Roentgenologic examination gave positive evidence of ulcer in 19 of the 46 gastric cases, and in 52 of the 73 duodenal cases. Most of the patients with perforation had no such examination. Four who were examined showed free gas in the peritoneal cavity. The ulcer in one patient admitted in 1935 perforated while he was standing behind the fluoroscope, and gas could be seen escaping from the duodenum. He was operated upon, but died later from embolism.

The majority of patients who received medical treatment, and these constituted more than half the number of patients admitted, were dismissed from the hospital as improved. There is record of only three such patients returning to the hospital later for operation. During the ten-year period 43 other patients entered the hospital supposed to have peptic ulcer, but complete examination failed to confirm the diagnosis.

*Statistics in Diseases of the Biliary Tract.*—Of the 64 cases of biliary tract disease, 12 were in males and 52 were in females, the youngest patient being 14 and the oldest 60. There were 12 cases of acute cholecystitis, in three of which empyema was present; and 52 cases of chronic cholecystitis. Fifteen patients had jaundice, which is not easy to detect in a colored person.

Stones were found in the gallbladder in 19 cases, and in the common duct in three. Roentgenography showed gallbladder calculi in all but three cases.

Thirty-seven patients were operated upon, 26 having cholecystectomy and 11 cholecystostomy. The gallbladder was drained in three instances, and removed at subsequent operations.

Eight patients died, giving a mortality rate of 14 per cent. Four of the patients were operated upon, two of whom had common duct stones, anastomosis between the common duct and duodenum being attempted in one instance. Another patient died following cholecystectomy, and another following cholecystostomy, complicated by blood stream infection. Of the four fatal cases in which no operation was performed, one had acute cholecystitis, one empyema of the gallbladder, one nephritis, and one suspected carcinoma of the gallbladder.

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## LIVER RESECTION

CASE REPORT AND ADVANTAGES OF RADIOCUTTING

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RESECTION of the liver has not been of frequent occurrence. Few surgeons have operated upon more than one such case, but 21 members of this Association have had a total experience of 24 cases. Fifteen of these have been reported in the literature, but eight including this communication have not been previously reported.\*

The cases collected by Thoele,<sup>1</sup> in 1913, doubtless include most cases reported up to that date. It is evident that this procedure is important enough so that it should be kept in mind by surgeons.

The safety to life and permanent results might have been more satisfactory had the operators been familiar with methods previously used. The diagnosis of liver tumor before operation has seldom been made, hence preparation for dealing with it has been quite inadequate. The difficulties of liver resection depend largely on the location, attachment, character, and size of the growth. Pedunculated growths are almost always easily managed and fortunately are of somewhat common occurrence. Growths at or near the anterior edge of the liver, because of their accessibility, are also usually relatively easily removed. Growths on the under surface of the liver are usually less easily removed, also those located high under the diaphragm or far toward the back. Extensive growths frequently, although not always, offer greater difficulty. Any growth when embedded deeply in the substance of the liver is more apt to prove troublesome.

### CONTROL OF HEMORRHAGE

This is by far the most important problem in liver resection. Oozing is apt to be profuse and persistent with ordinary cutting methods. The liver tissue is friable and frequently does not hold ligatures or sutures particularly well. Large vessels embedded in the liver substance are sometimes difficult to pick up with artery forceps or tie readily. The many methods of controlling hemorrhage which have been used indicate that there is no single infallible method.

*Controlling Hemorrhage.*—Temporary control of profuse oozing has been obtained by pressure of gauze wrung out of hot saline solution and applied to the cut surface. Adrenalin has sometimes been added to the solution. The liver has been held compressed by assistants or in certain instances

\* This number has been greatly increased by personal communications to me since this paper was presented before the American Surgical Association at Boston, June 8, 1935, and will be included in a paper now in preparation.

# LIVER RESECTION

temporary clamps have been applied. Lillienthal controlled hemorrhage by traction on the growth during removal. The vessels supplying the liver have been temporarily compressed by rubber covered clamps (John R. McDill<sup>2</sup>). This same method was reported (independently?) by Borzeky and Baron<sup>3</sup> a year later. Superheated air was used by Hollander.<sup>4</sup>

Gauze packing by Mikulicz, or other methods, has been left in place for several days; sometimes its removal has been followed by secondary hemorrhage. Elastic ligature, sometimes held by transfixion pins; also extraperitoneal treatment of the stump, was used by a number of earlier operators. These methods have not been employed recently because of slower healing and the risk of infection. Suture through liver substance over some supporting structure has been used; metal and celluloid plates, fresh or decalci-

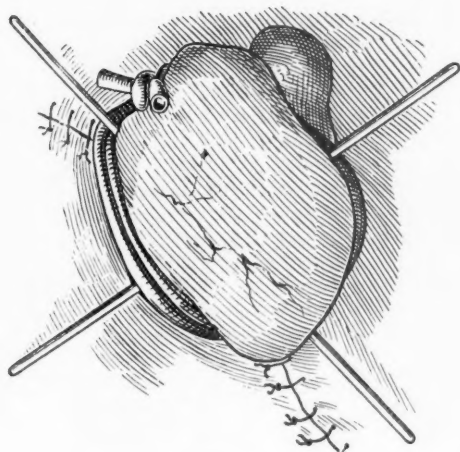


FIG. 1.

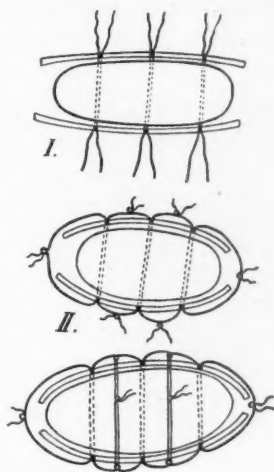


FIG. 2.

FIG. 1.—Shows transfixion holding elastic ligature (now seldom used).  
FIG. 2.—Suture chain ligature. Has been used with or without support of metal, celluloid, bone plates, or fascial strip to prevent cutting of liver substance.

fied bone and fascial strips have been employed for this purpose. The method of Leonard Freeman, to be described in the discussion, seems the simplest and most practical of these. The actual cautery has been used in cutting by several with excellent results; it does control oozing and many of the small and medium sized vessels and destroys malignancy. Whether it accomplishes these ends as satisfactorily as electrosurgery will be discussed later. Various forms of mass suture without other support, as mentioned above, have been used since the earliest liver resections and are still the main dependence for control of hemorrhage by a large number of surgeons. The mattress suture is far more commonly used; cobbler stitch, interlocking suture, chain suture, Lembert suture, and continuous whipping over of the cut edges are mentioned.

*Electrosurgery* seems well established as the standard procedure in many lines of surgery. The only records of its use for liver resection are three besides my own. Ward<sup>5</sup> reports excision in 1930 of a liver sinus persisting

one and one-half years following drainage of a large echinococcus cyst. The excision extended down close to the vena cava, and the hemorrhage was so well controlled that it was possible to close the abdomen without drainage; a good recovery followed. Howard Gray<sup>6</sup> reports removal of a squamous cell epithelioma Grade 4, involving the region of the gallbladder, 12 cm. in diameter, by diathermy, controlling larger bleeding points by coagulation, ligation and mattress suture. He emphasizes the value of diathermy in resecting malignant lesions which when dissected by knife would be exceptionally difficult. Coller, of the University of Michigan, began a resection of an adenocarcinoma of the left lobe by coagulating current but discarded it in favor of the scalpel. A number of surgeons presented evidence of the value of electrosurgery at a recent Symposium of the American College of Surgeons. The brain surgeons, following the leadership of Harvey Cushing, all use it. De Quervain of Bern, Switzerland, uses it in his goiter surgery. Its



FIG. 3.—Photograph of pieces of liver cut by cautery, middle; scalpel, left; radiocutting, right.

value in dealing with other highly vascular parenchymatous organs has been shown by both experimental and clinical experience and it should be more widely used especially in such work.

An experimental study on dogs of electrocutting and coagulation in the surgery of highly vascular organs was made by Ward and Pearse<sup>7</sup> at the Hunterian Laboratory, Johns Hopkins Medical School. They found it possible to arrest oozing while cutting and control larger vessels by clamp and coagulation without the use of any other measure. Scott<sup>8</sup> reported five cases of removal of renal calculi through an electrosurgical incision, and also resection of the kidney. Pugh<sup>9</sup> has also done nephrotomies and resection of the kidney electrosurgically. During the past six years I have personally used electrosurgery in 780 goiter operations, many of them extremely vascular exophthalmic or malignant growths, which would have oozed profusely with ordinary sharp cutting. I believe it safer to tie all moderate sized as well as larger vessels. Its advantages in malignant goiter were brought to the attention of this Association in 1931,<sup>10</sup> by the author. The conditions in kidney and cer-

## LIVER RESECTION

tain goiter surgery as concerns oozing and the friable character of the tissues through which sutures or ligatures, readily cut, are quite similar to those met in liver surgery. Radiocutting is far less destructive than actual cautery; it cuts much faster and I consider it equally efficacious in arresting oozing. It has given me better results during five years' use than any of the three spark-gap high frequency outfits which I have tried.

### REGENERATION AND BLOOD SUPPLY

A favorable factor in liver resection is that regeneration occurs promptly and quite completely. Ponfick,<sup>11</sup> over 40 years ago, reported experimental studies showing this. These studies were confirmed by Von Meister,<sup>12</sup> who removed up to four-fifths of the organ in rabbits, rats and dogs. Recently Fishback<sup>13</sup> removed one-fifth to three-quarters of the liver and found four-fifths regeneration in six to eight weeks. Clinically, Wendel<sup>14</sup> has shown that these experimental results can be relied upon. July 18, 1910, he removed most of the right lobe from a woman of 44 for primary adenocarcinoma. Two years later it was necessary to excise a considerable part of the colon and enlarged lymphatic nodes; microscopically the growth was similar in structure to the liver tumor previously removed; the liver itself showed no recurrence. The patient died August 25, 1919, and postmortem examination showed extensive local and metastatic recurrence. Wendel suggested to his associate, Martens<sup>15</sup> that study of the blood supply of the liver would be of value to those who might be called upon to do a resection. His injection and corrosion specimens show that the right hepatic artery anastomoses with branches of the left lobe (Fig. 7), so that either lobe would probably receive adequate blood supply if the artery of the opposite side were divided. It also shows that the left lobe and lobus quadratus are supplied by the left branch of the hepatic artery: that the right lobe is supplied and the lobus caudatus mainly supplied by the right hepatic artery but that the lobus caudatus also receives a small branch from the left hepatic artery. This distribution of blood supply safeguards remaining liver substance in case radical resection of either lobe is necessary, with sacrifice of blood supply of that side.

### TUMORS REQUIRING LIVER RESECTION

There have been reported a number of resections for growths, proved by pathologic examination to be gummata. Among members of this Association, Abbe<sup>16</sup> and Thompson<sup>17</sup> have both reported such cases. Ransohof<sup>18</sup> reported excision of a tuberculoma. Several growths reported to be adenoma have later proved to be malignant, probably adenocarcinoma. In some instances these growths have been reoperated upon; in others postmortem examination or clinical symptoms have left little doubt as to their malignancy. Among malignant growths sarcoma has been relatively infrequently reported. Elliott<sup>19</sup> reported such a case. Ewing<sup>20</sup> indicates that there is great difficulty in determining the exact character of the growth in these cases and questions the

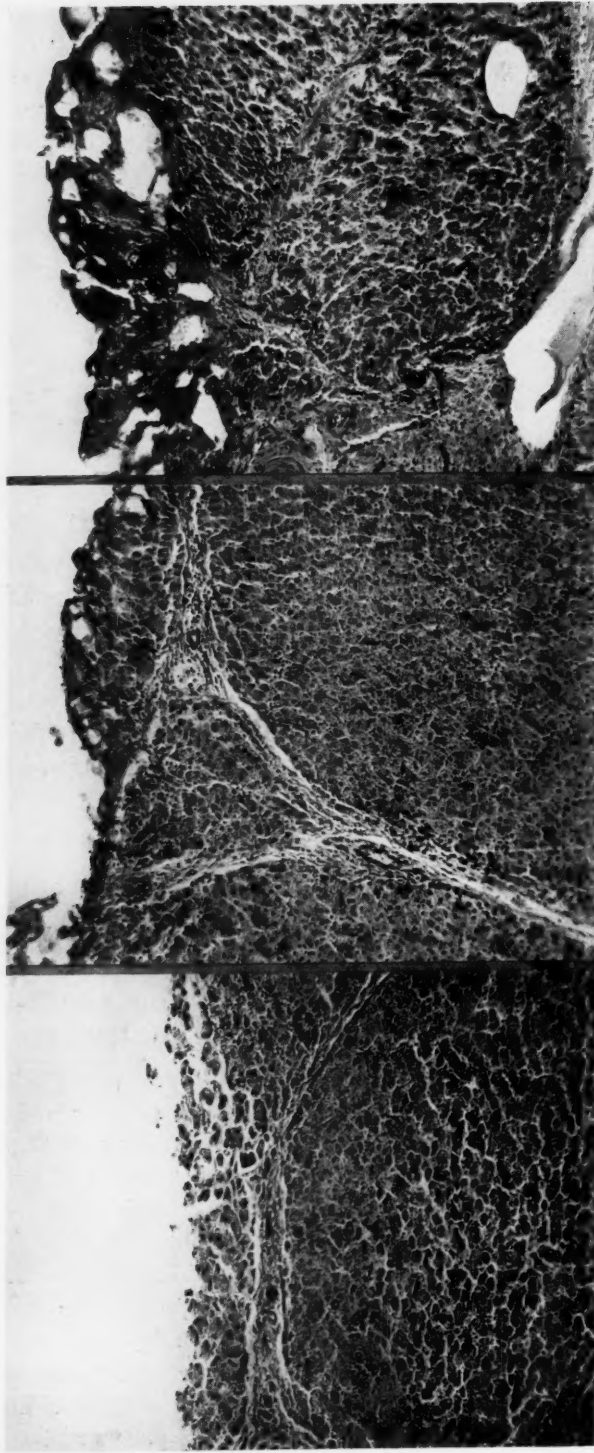


FIG. 4.—Photomicrograph showing liver surface cut with scalpel.

FIG. 5.—Photomicrograph showing liver surface with radio cutting (electro-surgery).

FIG. 6.—Photomicrograph of liver cut with actual cautery, showing extensive destruction.



# LIVER RESECTION

occurrence of sarcoma. The same is true of hypernephroma affecting the liver. Echinococcus cysts have been treated by resection of the liver by a number of surgeons, frequently because of mistaken diagnosis: simpler methods are now generally used. The two most important growths requiring liver resection are hemangioma and primary cancer of the liver. Because of their greater frequency and the possibility of curability I shall discuss these growths in more detail.

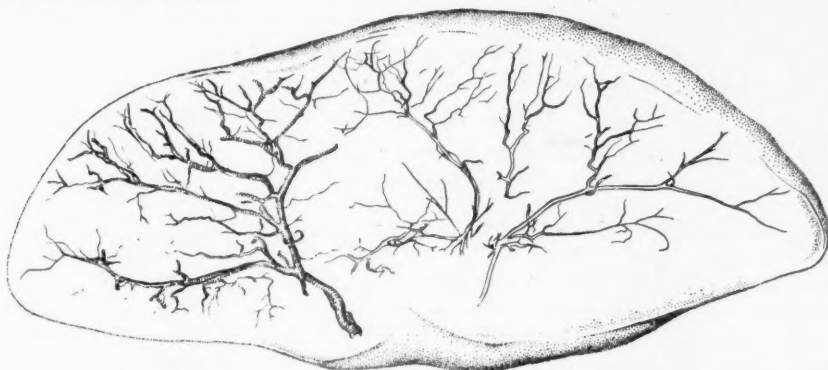


FIG. 7.—Drawing made from half tone of Martens article in Arch. f. klin. Chir. see text, for complete reference. Shows filling of blood vessels of left lobe of liver when right branch of hepatic artery is injected. The free anastomosis would be favorable to extensive resection in case either branch of the hepatic artery was cut off.

*Cavernous Hemangioma* offers special difficulties with regard to hemorrhage. The tumor is so thinned walled, in some instances, that rupture occurs and hemorrhage causes the symptoms which first call attention to some serious intra-abdominal condition. This occurred in the case which I report. Turner<sup>21</sup> reported the case of a patient admitted to Guy's Hospital in collapse; a diagnosis of ruptured ectopic pregnancy was made: the abdomen

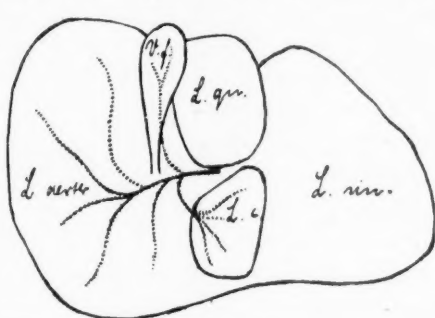


FIG. 8.—Distribution of right branch of hepatic artery to right lobe and most of lobus quadratus.

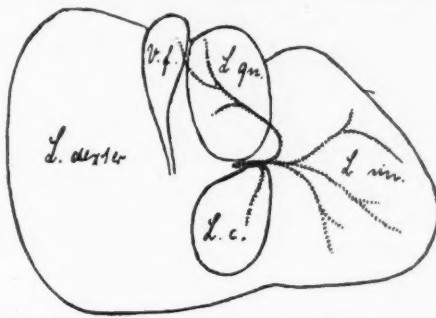


FIG. 9.—Distribution of left branch of hepatic artery to left lobe, lobus quadratus and twig to candate lobe.

was found to be full of blood; the pelvis was normal; hemorrhage from a liver hemangioma could not be controlled by suture or packing; the tumor was removed by cautery and the patient was given an infusion but died after one hour. There seems a possibility that this patient might have been saved by transfusion of her own blood taken from her abdomen: this method was first suggested by Halsted: I have used it successfully in a case of severe

bleeding from ectopic pregnancy. Severe hemorrhage from a needle prick of a huge angioma of the right lobe is reported by Mantle<sup>22</sup> and quoted by Chas. H. Peck.<sup>23</sup> The hemorrhage was uncontrollable by suture or packing and the patient died after two hours. Fatal hemorrhage was also reported by Borst and Chiari<sup>24</sup> and by a number of others. The fairly frequent pedunculated hemangiomas are much less difficult and dangerous. Peck<sup>23</sup> reported a pedunculated hemangioma involving the entire left lobe which was removed after clamping the pedicle and closing the stump with continuous catgut suture; the tumor weighed 3 pounds 14 ounces (1,759 Gm.), the largest tumor removed in this country up to the time of this report. Clar<sup>25</sup> gives details of a successful operation by Schloffer, with a report of 30 others from the literature, an operative mortality of slightly over one-third of 1 per cent. This perhaps gives a fair estimate of present day risk.

**CASE REPORT:** A woman 65 years of age consulted Dr. H. E. Merriam because of abdominal pain. Her condition did not seem serious but there was some abdominal tenderness localized mainly in the right lower quadrant. There was a history of dull abdominal aching for 30 years. The family and past history were unimportant. General physical examination satisfactory. The following morning the pain became more severe, was localized at McBurney's point and the patient was sent to the hospital and prepared for operation. The abdomen was opened and much free blood was found, some old and clotted. No source of bleeding was discovered in the lower abdomen but an actively oozing tumor was found attached to the left lobe of the liver. This was resected wide of the growth with medium cutting radiocurrent, which controlled all smaller vessels. Larger vessels were controlled and approximation of the defect effected by mattress sutures of plain catgut. Xeroform gauze drain was left to line of suture. Clysis was given. Recovery was uneventful. The patient is living and well 16 months after operation. Pathologic Diagnosis: Hemangioma of the liver.

#### MALIGNANT TUMORS OF THE LIVER

Many writers are pessimistic towards resection of these growths. This has probably led many surgeons to abandon attempt at their removal, although the experience of Keen,<sup>26</sup> McArthur,<sup>27</sup> and Yeomans<sup>28</sup> among the Americans and the successes of a number of foreign surgeons have shown the possibility of cures up to seven years' duration. A reliable pathologic diagnosis is indispensable in such cases. In Keen's<sup>26</sup> case the pathologic diagnosis, cylindrical cell cancer by Coplin and Tinker, was confirmed by Wm. H. Welch and T. M. Prudden: in McArthur's<sup>27</sup> case pathologic diagnosis, adenocarcinoma by Hektoen and Zeit, was confirmed by Fenger: in Yeomans'<sup>28</sup> case the pathologic diagnosis, adenocarcinoma by Jefferies of the Philadelphia Polyclinic, was confirmed by Ewing.<sup>29</sup> McArthur's case involved especial difficulties, for the liver was involved by extension from stomach cancer, so that resection of the stomach as well as the liver was required: the later pathologic diagnosis was true carcinoma. Alessandri<sup>29</sup> states that "in carcinomata of the liver, surgery is of scarcely any interest as they are operable only in exceptional instances." He does state farther on that "adenocarcinomata, especially when they develop in accessory lobes . . . are in consequence insolated and sometimes circumscribed and pendunculated

and may be operable," also that "metastases . . . are rarely seen." Ewing<sup>20</sup> and McCallum<sup>30</sup> also confirm this statement as regard metastases. The improvement in methods and additional resources of recent surgery have much improved the prospects of cure. Case reports have been collected by Keen,<sup>26</sup> Thoele,<sup>1</sup> Yeomans,<sup>28</sup> and Castle.<sup>31</sup>

It should be noted that unfavorable statistics, in several cases, are based upon operations which were performed under conditions less favorable than the present, 25 to 40 or more years ago. Also that Keen's tabulation, pub-

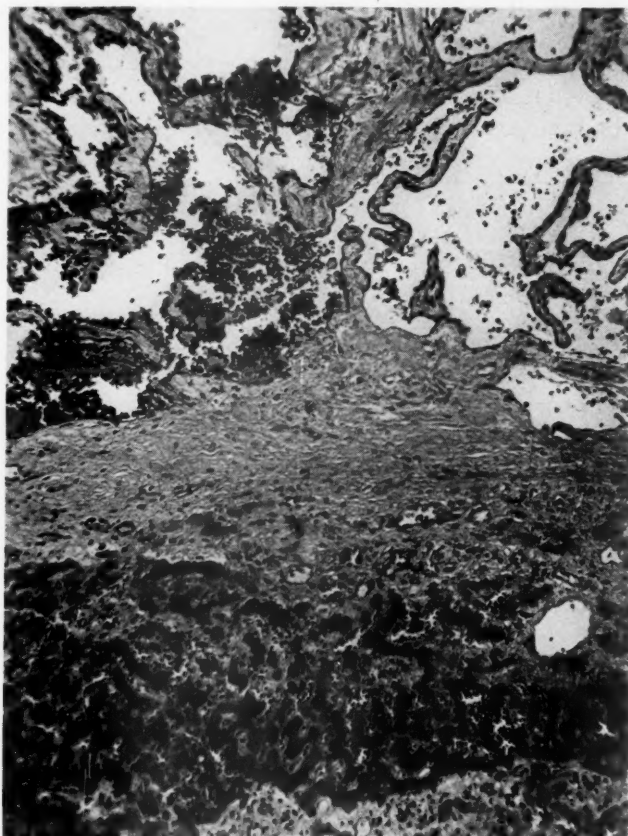


FIG. 10.—Photomicrograph of the hemangioma of liver reported.

lished in 1899, includes two patients living three years after operation which were apparently overlooked by Thoele in 1913. All but two of Thoele's collected cases were operated upon 25 or more years ago: but even at that time two of these (6 per cent plus) were apparently living and well three or more years postoperatively, and four (12.5 per cent) lived three and one-half years or more, a gain in life which at least in some cases would warrant operation. Yeomans' tabulation, which includes several cases operated upon 20 years or less ago, shows six (37.5 per cent) of 16 patients alive and well three to seven years after operation. This compares fairly favorably with the re-

sults in thyroid malignancy which also deals with a glandular, very vascular, organ. Most of the improvement in the results in the treatment of thyroid malignancy seems to have come from recognition of the value of irradiation combined with surgery: neither irradiation nor surgery alone gives results comparable with the combination of the two. Is it not possible that such improved results might come with this combination in liver surgery? Earlier exploration, as urged by Keen and Yeomans, is also highly important, for in extremely few cases has liver malignancy been suspected before the abdomen was opened; almost every other possibility has been first considered. A disadvantage unlikely to be avoided is that the experience of the individual surgeon is likely to remain small. Adenocarcinomata, which makes up a large percentage of liver malignancies, often grow slowly and metastasize late if at all, as stated by Ewing and McCallum, and are classed as radio sensitive.

With improved aseptic and antiseptic technic; with methods of anesthesia adapted to the individual case; and with some knowledge of the experience of the many others who have previously operated, results both as to safety and permanent cure should show still further improvement over earlier reported cases.

## CONCLUSIONS

(1) The incidence of liver tumors is large enough so that their occurrence should be kept in mind.

(2) Reproduction of liver tissue has been shown experimentally and clinically; the blood supply is favorable and both experimental and clinical evidence indicates that large growths can be excised safely.

(3) Radiocutting combined with other methods suited to the individual case, transfusion of the patient's own blood from within the abdominal cavity in bleeding hemangiomas; and radium combined with surgery in malignancy may help to raise the percentage of cures.

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<sup>25</sup> Clar: Med. klin., vol. 24, p. 1746, November 9, 1928.  
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<sup>27</sup> McArthur: ANNALS OF SURGERY, vol. 42, p. 626, 1905.  
<sup>28</sup> Yeomans: J. A. M. A., vol. 44, p. 1301, 1915.  
<sup>29</sup> Alessandri: Nelson Loose Leaf Surgery, vol. 5, p. 598, 1928.  
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DISCUSSION.—DR. HOWARD LILLIENTHAL (New York).—In discussing Dr. Tinker's most interesting paper let me give my experience in two cases that I have had. The first one, a man of about 50, was operated upon long ago. The tumor depended from the right lobe of the liver. I extirpated it. As I drew the tumor downward during its removal I could see the vessels like the strings of molasses candy when you pull it apart. I caught every one and tied them. I had no trouble, whatever, and my impression is that I sutured the defect afterward. The neoplasm proved to be an hypernephroma. The patient recovered but because of inexperience in those days I did not investigate the case further nor follow the patient later on. It probably was a secondary hypernephroma, I would now make every possible effort to find the primary lesion, since in hypernephroma there may be a single or solitary metastasis.

The other case was one of hemangiosarcoma, a large one in a woman. It also was in the right hepatic lobe. My impression is that I made use of a pin with the elastic ligature during the extirpation. The case was an extremely difficult one. I think that this patient died a year or more after an operative recovery.

I have had several patients with hydatid cysts of the liver. In one of them there were five present; I took out three at one time and two at a subsequent operation. The man got well. Another had a single hydatid cyst. It was found accidentally while operating for gallstones. I did both operations at one time with recovery.

I am very partial to electrosurgery of the right kind. You should have a current that will cut rapidly. The so called radiocurrent I have had no experience with in the liver. I use it for the skin always and get much better primary union than with the scalpel. If you use it for the skin you should make the incision quickly. A slowly made incision will kill the adjacent tissue. I use electrosurgery in all my work except the intrathoracic, and I am afraid to use it there because cases have been reported, but not published, in which the patient has died on account of electric shock to the heart muscle. In most other parts of the body, you will have nothing but good luck if you handle the radioknife correctly.

DR. LEONARD FREEMAN (Denver, Colo.).—Doctor Tinker has described what seems to be an excellent method for resection of the liver, provided one has the proper apparatus at hand. But the necessity for a resection sometimes comes unexpectedly when an electric knife is not available.



In such emergencies it is well to have some other means up one's sleeve. There are a number of more or less good methods which may be used; but one which I suggested before this Society some years ago has advantages in the way of simplicity and effectiveness which make it deserving of attention. It has served me well on several occasions.

The paraphernalia required consists of two mattress needles, or two sections of stiff wire, about a foot or more in length. One of these is laid along the upper surface and one along the lower surface of the section of liver to be removed, well back from the tumor. With a long straight or moderately curved needle, plunged through the liver, two or more loops of catgut are slung, at appropriate distances, around the lower mattress needle and over the upper one.

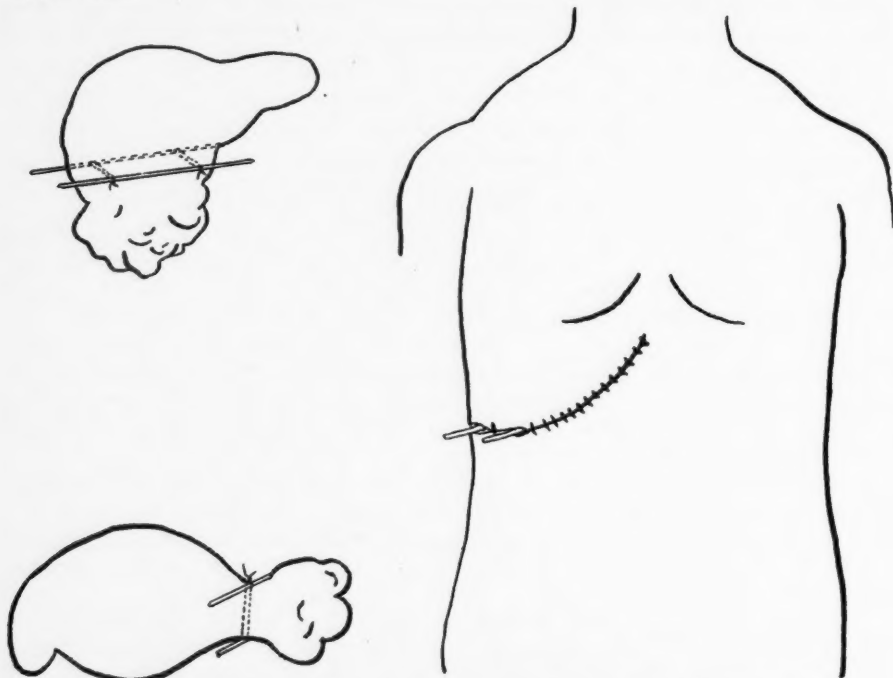


FIG. 11.—Showing mattress needles in place, held by catgut loops passing through liver.

FIG. 12.—Lateral view of liver and tumor and needles in position.

FIG. 13.—Showing needles brought out through incision.

When the loops are tightly tied they compress the liver substance between the wires so that no bleeding can occur and the needles cannot slip. If the incision is oblique the ends of the needles are conducted out of its lateral extremity onto the abdominal wall, or a separate stab wound may be made for this purpose (Figs. 11, 12 and 13). At the end of a number of days the needles are easily pulled out, leaving the catgut loops to be absorbed later on.

DR. FRED B. LUND (Boston, Mass.).—I have nothing, whatever, to contribute to the technic of removing tumors of the liver. I am simply speaking of this case on account of the condition for which it was done. Some 30 years ago I was called upon to operate upon a woman suffering from a tumor of the liver. It was before roentgenography and also before the time of electric knives.

She had an enormous tumor in the upper right quadrant extending way

## LIVER RESECTION

down below the umbilicus. We thought it was a tumor of the kidney. Her urine was normal. She was about 50 years old. She had no loss of weight, but just presented this great big tumor that was bulky and bothered her greatly.

You are all familiar with congenital cystic kidneys. This patient had a congenital cystic liver. The cysts were not distributed through the liver. It was all one mass. By taking out a big, wedge-shaped piece of the right lobe, I could get rid of it and I did shell it out. There was the usual bleeding and transfusions were just beginning to be done. I used hot water. I had some great long blunt needles and brought the surfaces together, except at one point where I had to pack with gauze. We have all had some experience with packing with gauze in cases of ruptured liver, and it works a good many times. In taking out gallbladders you sometimes get into the liver, expose the raw surface, and that can always be cured by packing.

I do not think the venous blood pressure in the liver is high at all. In bringing in the blood they spread out like a mountain stream flowing into a lake and there is no current to speak of in the lake and the current is slow in the river. I always thought it was a hopeful point.

One chief difficulty is the fact that sutures cut through the soft liver tissue. In cases such as Dr. Freeman has suggested, I think that his method is excellent if it can be applied. I did sew this liver up with mattress sutures and a gauze drain, and while we were arranging for a donor she died from hemorrhage and shock.

DR. EDWIN BEER (New York).—In connection with the use of the radio-knife, it is of interest to know that in 1908 or 1909 the radio expert Lee deForest asked me to try out the cutting current on animals in the Loomis Laboratory in New York. The cutting effect of this current was satisfactory, but its hemostatic effect, especially in organs like the liver, as Dr. Tinker indicated, was imperfect. Large vessels remained open and bled. Since then we have been able to produce a combined cutting current and electro-coagulating current which frequently controls the bleeding. The disadvantage from electrocoagulation of the tissue to control bleeding is in the fact that this coagulated tissue may invite infection. Both currents are high frequency currents with very rapid oscillations.

I have personally had experience with two cases of liver resection, one case an hemangioma of the liver. It was impossible to control the bleeding completely by all sorts of ingenious devices. In another case of sarcoma of the right lobe of the liver, a resection was rapidly made and the bleeding controlled by enfolding stitches of the thinned out liver edge surrounding the sarcoma so that no packing was necessary to control the oozing. The tumor was the size of an orange, easily removed, and the patient died five and one-half years later with multiple metastases in bones, liver, spleen and kidney.

In closing, I believe it should be emphasized that the high frequency cutting and coagulating currents are invaluable in resection of hollow organs, especially the bladder, where I have been using these currents for over 11 years.

DR. JAMES M. MASON (Birmingham, Ala.).—Relative to the question of autotransfusion, this has been extensively and successfully used by gynecologists in ectopic pregnancy. It has been used rather infrequently in other conditions, although in any uncontaminated intra-abdominal hemorrhage I see no reason why the blood would not be just as available for autotransfusion as in ectopic pregnancy. I have used it very successfully in ruptured spleen. I have not used it in ruptured liver.

I see no reason why blood that is uncontaminated by injury to the urinary or intestinal tract might not be used in case of hemorrhage from the liver, unless associated with the malignancy of the liver, where there might possibly be danger of picking up cancer cells.

DR. JOHN J. MORTON (Rochester, N. Y.).—Relative to the use of extravasated blood from the liver as a transfusion, we were warned, in Dean Lewis' clinic, at Baltimore, that blood extravasated from the liver is very dangerous as it carries a toxic choline derivative in it.

DR. EMMETT RIXFORD (San Francisco, Calif.).—Doctor Tinker spoke of the capacity of the liver for regeneration. It is certainly remarkable, as may be shown from the following example: A man came to hospital with enormous masses of varicose veins extending from each groin to the corresponding axilla, evidently the result of obstruction of the vena cava. He gave a history of having had typhoid fever in the Presbyterian Hospital, New York, 14 years previously, followed by swollen legs. From the hospital it was learned that the typhoid had been accompanied and followed by phlebitis of the iliacs and vena cava. Some months later the patient returned to the hospital suffering from abdominal pain. Fatal peritonitis suddenly developed. Autopsy showed that the right lobe of the liver had been entirely replaced by two large cysts, one of which had ruptured, causing the peritonitis. The left lobe of the liver had hypertrophied to be as large as both lobes of the normal liver. It may be of interest to state that the ascending vena cava was represented by a bone which extended from near the level of the renal veins downwards into the iliacs.

DR. MARTIN B. TINKER (Ithaca, N. Y.).—It may interest the American Surgical Association to recite a list of their members who have reported cases of liver resection in the past: Dr. McLean Tiffany, Baltimore, Dr. J. W. Elliott, Boston, Dr. Monks, Boston, Dr. Alexander Hugh Ferguson, Chicago, Dr. Louis McArthur, Chicago, Dr. Oliver, Cincinnati, Dr. Ransohoff, Cincinnati, Dr. Leonard Freeman, Denver, Dr. Robert Abbe, New York, Dr. Willy Meyer, New York, Dr. Charles Peck, New York, Dr. W. W. Keen, Philadelphia, and Dr. Alexander Maclaren, St. Paul.

Of this list, Doctor Keen reported three cases, Doctors Ferguson and McArthur two, and the others only one. Doctor Elliott of Boston gave a paper on resection of the liver before this Association in the '90's, about 40 years ago. Dr. Leonard Freeman reported on resection of the liver before this Association in 1904, 31 years ago. In the meantime, I have not been able to discover that there has been any report on resection of the liver.

This is a condition, then, which from the experience I have had within the few months I have been preparing this paper, has been impressed upon me as likely to occur in the practice of any man who does much abdominal surgery. In this connection, it is interesting to note that Doctor Finney had two cases, who appeared in his office on the same day and were operated upon on consecutive days. It is a condition, I believe, that is likely to occur in the experience of any man, and if you have not met with a tumor of the liver and have not been called upon to resect it, it is sometimes rather awkward. Some of you have had experience with the traumatic injuries of the liver and know they can bleed. Some of these cases do not bleed very much during resection. Others of them would bleed excessively unless properly handled.

So many cases have been brought to my attention since I started preparing this paper that I intend to send out a questionnaire to the members of the Association, to determine how many have had experience with tumors of the

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liver. Evidently only a small proportion of the tumors that have been operated upon have been reported, and it is occurring in practice without previous experience, more or less of an emergency situation.

Regarding Doctor Beer's comment: I looked up all the references that were available in the Surgeon General's Index Catalog and the Cumulative Index, but the way that the tumors of the liver are indexed makes it difficult to find them in some instances. Many references were accidentally found and were not among the regularly listed reports of liver surgery.

As regards the regeneration which Doctor Rixford has spoken of, I mention in the paper that up to three-fourths of the liver has been removed experimentally by a number, the latest being Fishback of the Mayo Clinic, who found that the liver regenerated, after four-fifths had been removed, in from six to eight months.

## CONGENITAL OBSTRUCTION OF THE BILE DUCTS

WILLIAM E. LADD, M.D.

BOSTON, MASS.

THIS paper is based on a study of 45 cases of congenital obstruction of the bile ducts occurring in the Children's Hospital of Boston.

According to Yllpo<sup>1</sup> and other observers, the bile ducts in their process of development pass through a solid stage analogous to that of the intestine. That is, the lumen of the ducts becomes obliterated by epithelial concrescence or proliferation. If normal development continues, this solid cord becomes vacuolated, the vacuoles coalesce, and the lumen becomes reestablished. An arrest in development during the solid stage more adequately explains the malformations found than any of the other theories advanced. The cause of the arrest in development still remains a matter of surmise.

The gross pathologic findings associated with these obstructions of the biliary ducts are a general icterus of all the tissues of the body, an enlarged liver with increased firmness to touch and an irregular pebbly surface of darker color than normal, and a wide variation in the malformation of the ducts (Figs. 1 and 2).

Microscopically, one finds in the liver a marked interlobular and intra-lobular fibrosis with slight round cell infiltration in some cases. The bile capillaries are plugged with greenish-black inspissated bile. The liver cells contain small granules of bile pigment. Particles of bile pigment are also found in phagocytic cells of the small capillaries in the interstitial fibrous tissue. In short, the liver presents the picture of bile stasis and biliary cirrhosis (Fig. 3). The pathologic findings in other parts of the body are not remarkable.

In 1916 Holmes<sup>2</sup> collected 120 cases from the literature and described a large number of variations in the malformations. While it is true that almost no two cases are exactly alike, still for practical purposes it is possible to classify these malformations into a small number of groups.

- (1) Cases in which there are no extrahepatic ducts.
- (2) Cases in which there is an atresia of the hepatic ducts.
- (3) Cases in which there is an atresia of the common duct.
- (4) Cases in which the gallbladder is represented by a moderate sized cyst not connected with the common duct and in which there may or may not be any common or hepatic ducts.
- (5) Cases in which the gallbladder connects directly with the duodenum but in which there are no other extrahepatic ducts. That is, no ducts connect the liver and gallbladder or the liver and intestine.
- (6) Cases in which there is a stenosis of the common duct plugged with inspissated bile causing complete obstruction.



## CONGENITAL OBSTRUCTION OF BILE DUCTS

- (7) Cases in which there is narrowing of the common duct causing partial obstruction.

The diagnosis of congenital obstruction of the bile ducts may be quite difficult to make in the first few weeks of life but it becomes simpler as the infant grows older. The jaundice may be present a few days after birth but does not become marked until the infant is two or three weeks old. As the infant enters the second month of life the jaundice becomes more intense but of a greenish-yellow tinge rather than the marked yellow seen in biliary obstruction of adult life. The stools are acholic as a rule but may at times give a positive test for bile or show gross evidence of bile on their surface even in the cases of atresia or complete absence of extrahepatic ducts. This



FIG. 1.—Shows cut surface of the liver. Note the fibrous tissue interspersed throughout the parenchyma and the dark color due to bile stasis.

phenomenon is explained by the fact that the bile is carried by the blood stream to the mucosa of the intestine and excreted by it into the lumen of the gut. The urine is dark colored and gives a positive test for bile. The icterus index is very variable in different patients and from day to day in the same patient and in our series has ranged from 50 to 200. This test compares serum with potassium bichromate 1-10,000 as the standard 1, and then compares the serum with the solution in greater concentration. The bleeding and clotting time may be slightly prolonged but no great variation from the normal has been found in this series. The fragility of the red cells is not abnormal nor is there a marked increase in erythroblasts. A red count and hemoglobin below normal have been observed in some of the patients. One

expects to find a positive direct van den Bergh reaction and no increase on the addition of alcohol. In other words, there is not a biphasic reaction. On physical examination these patients show a surprisingly good state of general nutrition and development even when several months old. The striking features are the general icterus and the enlarged liver with a very firm or hard edge.

The diseases of infancy with which congenital obstruction of the bile ducts might be confused are:

*Icterus neonatorum* is not a serious condition and usually has disappeared by the end of the second week of life. During the first two weeks after birth, however, the infant may present a very similar amount of icterus to the infant

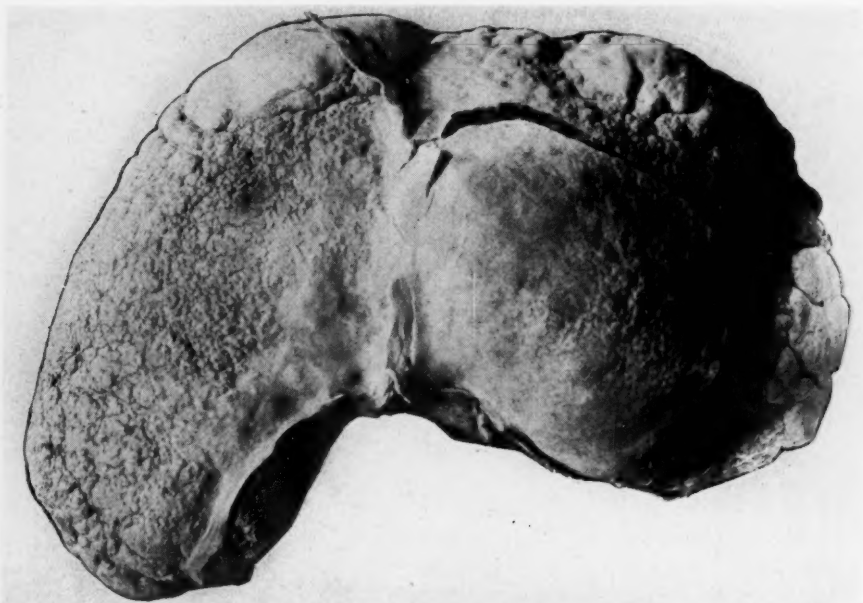


FIG. 2.—Outer upper surface of the same liver as Fig. 1 showing pebbly appearance present with marked degree of obstructive biliary cirrhosis.

with obliteration of the bile ducts. Such an infant does not present the enlargement of the liver, the acholic stools, or bilious urine found in the cases of biliary obstruction. These factors and time will remove the possibility of confusion between these two conditions.

*Erythroblastosis*, sometimes classified under the name of *icterus gravis*, may present a clinical picture simulating that due to biliary obstruction. The jaundice may be of like intensity and the liver show an equal or greater enlargement. In this condition it is common to have an associated splenomegaly. Clifford and Hertig,<sup>3</sup> Diamond, Blackfan, and Baty,<sup>4</sup> have mentioned the finding of a marked golden vernix caseosa and a hypertrophied placenta as important factors in making one suspect the presence of erythroblastosis. These conditions should be considered as indications for further investiga-

tion of the patient rather than factors in making the diagnosis. The finding of an increased number of erythroblasts on successive blood examinations is an important factor in differentiating this disease. In erythroblastosis one expects to find a positive biphasic van den Bergh reaction. The positive direct reaction is due to the great increase in the hematopoietic centers in the liver and the biphasic reaction to the breaking down of the red cells. This condition is associated with a very high mortality in the first few days or weeks of life so that the chance of confusing it with malformation of the bile ducts becomes progressively less as time elapses. The treatment of erythroblastosis is multiple transfusions which yield a fair percentage of cures.

*Jaundice of hemolytic sepsis* may resemble that due to bile stasis and one might be confused, without careful study, by the fact that small infants

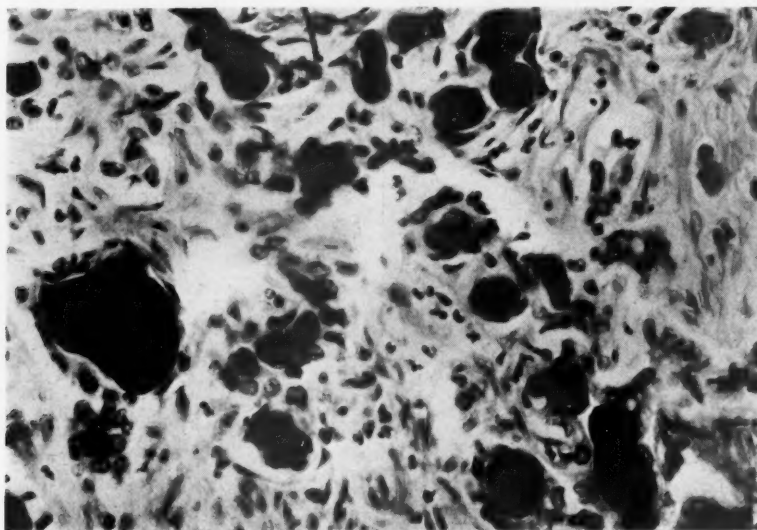


FIG. 3.—Photomicrograph of liver from a case of congenital atresia of bile ducts. Note dilated bile capillaries filled with black inspissated bile, and marked increase in fibrosis.

may be suffering from marked sepsis without showing a febrile reaction and also by the not uncommon enlargement of the liver with infection. Acholic stools, bile in the urine, a high icterus index, or progressively increasing jaundice are not seen in patients with sepsis.

*Congenital syphilis* should be mentioned in the differential diagnosis and in case of doubt investigated by a careful maternal history, a Wassermann reaction of mother and child and roentgenologic studies of the long bones of the child.

As a rule of thumb it may be stated that if one delays making a final diagnosis of congenital biliary obstruction until the infant is a month or six weeks old the chance of error is not great.

When one has made the diagnosis of congenital obstruction of the bile ducts exploratory operation is the obvious next step, as 100 per cent mor-

tality may be expected unless the obstruction is relieved. The only possible exception to this rule might be the passage of an inspissated bile plug in a patient with stenosis and not atresia of the bile ducts. This possible exception is of little practical value, however, as it is quite impossible to differentiate between stenosis of the ducts with complete obstruction and atresia, without resorting to exploratory laparotomy. The question of the age at which operation should be done is more debatable and must be decided somewhat on the merits of the individual case. With exceptions for particular indications it is better not to operate much before the end of the first month.



FIG. 4.—Roentgenogram of patient with atresia of common bile duct. Note rubber tube over which the end-to-side anastomosis of the common bile duct to the duodenum was made.

Nothing is lost by this delay and the assurance of a correct diagnosis is gained. It is not wise to wait beyond the second month as nothing can be gained by further delay in arriving at a correct diagnosis. These jaundiced infants have a low resistance to infections, especially respiratory infections, from which they may die before being given their one chance of recovery if the operation is put off too long.

The technic or type of operation used on these small infants varies of course with the lesion found but must be somewhat different from that used in operating on the bile passages of the adult. After opening the abdomen by a high right rectus incision the first problem which presents itself is finding out what type of malformation exists. This is not always easy on account of the small size of the structures, their variations from the normal, and unusual peritoneal folds from either colon or duodenum. In case the common duct is not readily identified, I have found it helpful to insert a small catheter into the gallbladder and inject saline through it. If the cystic duct is patent and the common duct is not, this procedure will distend the common duct and make its isolation much easier and enable one to discover whether he is dealing with an atresia or stenosis and bile plug. If the latter, it may be dislodged by the pressure of the saline or, if that is not successful, a probe may be passed through to the duodenum. When an atresia of the common duct is demonstrated, one of two or three procedures may be followed. The gallbladder may be anastomosed to the stomach. This is a comparatively simple procedure and has been done once with success in this series by one of my

former associates. This procedure has obvious disadvantages and is not the operation of choice except when the patient's condition does not warrant the somewhat more difficult operation of choledochoduodenostomy. In the patients with atresia of the common duct, the duct is so small that the ordinary methods of anastomosis are not feasible. In one instance it was possible to insert a small catheter through the gallbladder and cystic duct into the common duct. The blind end of the common duct was attached to the duodenum and openings made in both through which the catheter was passed. The anastomosis was completed over the catheter which was then withdrawn. In the other instances of common duct atresia the anastomosis was performed over a short piece of rubber catheter (Fig. 4), which was left in place to be carried on by intestinal peristalsis. Only one row of mattress sutures was used and this of very fine arterial silk, interrupted (Fig. 5). When the gallbladder was collapsed, and only a rudimentary structure and the cystic duct

Atresia of common duct, showing technique of end to side anastomosis

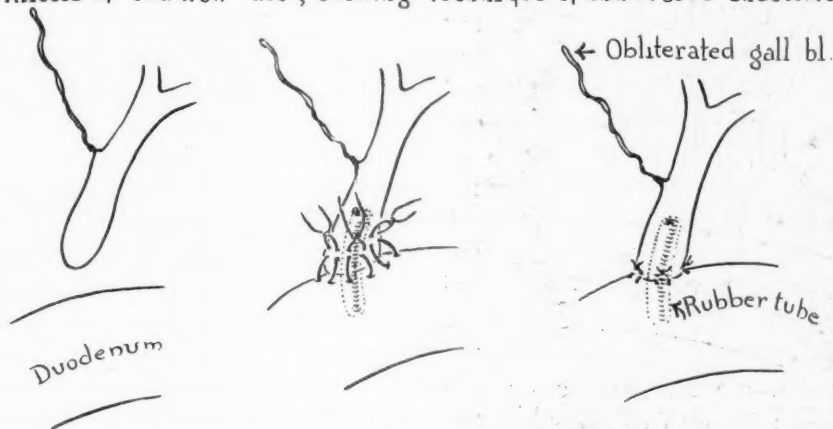


FIG. 5.—Atresia of common duct, showing technic of end-to-side anastomosis over a small piece of rubber tube using a single row of interrupted mattress sutures of fine silk.

was not patent, the gallbladder was freed from its bed and used to draw the common or hepatic duct into view. This procedure made it possible in one instance to identify the hepatic duct and perform a successful anastomosis between that and the duodenum in the same manner that has been described for the common atresia.

*Errors in Procedure.*—Some years ago my late chief explored an infant (Case No. 98080) for biliary stasis and found a moderate sized gallbladder which contained fluid resembling bile. He performed a cholecystoduodenostomy but no bile entered the intestinal canal. The patient subsequently died. More recently a patient (Case No. 144129) had a similar operation performed in Baltimore, and later came to our clinic because no bile entered the intestine and the jaundice remained the same as before operation. I reexplored this latter patient and found that an excellent cholecystenterostomy had been performed but that there were no cystic or other extrahepatic ducts. Post-



mortem examination confirmed my operative findings and was identical with the autopsy observations in the first case. These two patients had gallbladders but no extrahepatic ducts. The obvious lesson to be drawn from these two patients is that one should have good evidence of the gallbladder connecting with the liver before anastomosing it to the intestine.

Recently I explored a jaundiced infant (Case No. 167813) referred from Scranton, Pa. (Fig. 6). The usual procedure of inserting a catheter into the gallbladder and injecting saline to assist in identifying the ducts was followed. There was slight resistance to the injection at first and the saline then readily passed into the duodenum. It was felt that there had been a plugged duct which had been relieved. The patient made no improvement

after operation and at a second operation the condition which should have been recognized at the first was found. The gallbladder connected by the common duct directly to the duodenum. There was no hepatic duct. Simmonds<sup>5</sup> has reported two and Ashby<sup>6</sup> one identical case found at autopsy.

A three months old baby (Case No. 149320) was explored. A rudimentary gallbladder without patent cystic duct was found. What was thought to be the blind end of the common duct was identified and opened but no bile was apparent. A small catheter was tied into this and led out through the abdominal wound. There was profuse flow of bile through the catheter the next day. Two days later the wound was reopened and an end-to-side anas-

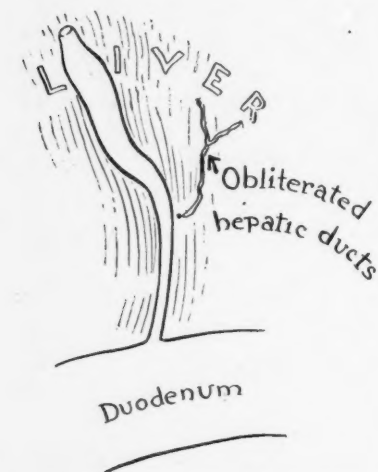


FIG. 6.—Case No. 167813.—Case in which the gallbladder was connected to the duodenum but in which the hepatic ducts were obliterated and there was no connection between either the liver and the duodenum or the gallbladder and the liver.

tomosis performed over too long a piece of rubber catheter. The post-operative convalescence was very satisfactory. Bile appeared in the stools and disappeared from the urine and the jaundice cleared, but the piece of catheter over which the anastomosis had been made was not passed. Two months later the baby developed signs of fluid in the abdomen and later evidence of pneumonia and died. Probably a third operation should have been performed for removal of the rubber tube. My theory was that the upper end of the tube had ulcerated through the bile duct allowing bile to escape into the peritoneal cavity and that the pneumonia was a terminal affair. The theory could not be proved as permission for autopsy was not granted.

A month old patient (Case No. 156370) was explored and no extrahepatic ducts found. Later at postmortem examination an atresia of the common duct was identified which could have been anastomosed to the duodenum. This case is included among the operable group.

PROGNOSIS

It is of course apparent that if there is a malformation of the bile ducts which prevents bile from entering the intestinal canal, the condition is incompatible with life. The surprising fact is the length of time which an infant can live with such a condition. In this series of 45 cases one patient with atresia of the hepatic ducts lived to the age of twelve months when he died of intraperitoneal hemorrhage. Another infant died at the age of ten months shortly after an exploratory operation had revealed the absence of extrahepatic ducts. The average duration of life was four and one-half months in five patients, all of whom had inoperable conditions not explored. In 20 patients who were explored and found to have inoperable conditions the duration of life was five and one-half months.

From the study of these cases one may deduce, therefore, that although an occasional infant may live for many months without bile entering the intestine the majority die within six months and some sooner. For this reason it is obvious that exploration should be resorted to before the fourth month of life.

Of the remaining 20 patients in this group all were explored and found to have conditions theoretically amenable to surgical treatment. They may be classified according to the malformation found and whether the obstruction was complete or not.

There were 15 cases in which the obstruction was complete and five in which the obstruction was partial.

Of the 15 cases in which the obstruction was complete five were due to plugging of a stenosed common duct with inspissated bile. These were all treated by the operation, mentioned earlier in the paper, of distention of the ducts with salt solution or with a probe. All were operated before the third month of life. Four of these patients recovered and were discharged from the hospital apparently well. One of them is reported to be in perfect health ten years, and one eight years after the operation. The other two have not been followed for so long a period of time but at last note were in excellent health. The one patient of this group who died was discharged from the hospital apparently well but died within two months and at autopsy the ducts were found to be replugged.

Six patients with atresia of the common duct were operated on under two and one-half months of age. Four recovered and two died. Of the four who recovered two had a choledochoduodenostomy done over a short piece of rubber tube, one a choledochoduodenostomy over a catheter introduced through the gallbladder, cystic and common duct, and one had a cholecyst-gastrostomy. These patients have been followed for nine years, six years, nine months, and six months respectively and all appear to be in excellent health.

There were five patients with atresia of the hepatic duct. Of these, one patient, on whom an hepaticoduodenostomy was performed with the same technic used in the common duct atresias, recovered and has been re-

ported free of jaundice and in excellent health at the end of two years. One patient made an excellent immediate postoperative recovery but died four months later. One patient who had been allowed to go to seven months of age died 48 hours after operation with symptoms suggesting hemorrhage. No autopsy was performed. One patient died at 12 months of age without being explored and one who was explored died at six months of age, a month after operation. In this last case no patent ducts were found at operation but a hepatic duct theoretically capable of being anastomosed was found at autopsy. It may be seen from these five cases that in our clinic at least the outlook in cases of hepatic duct atresia is less favorable than in common duct atresia. It also may be suggested that these cases offer possibilities of better results than we have obtained.

Five cases of partial obstruction have been included in this series as it is believed that they were due to congenital malformation of the bile ducts even though the symptoms did not all become apparent in the first weeks of life. However, the patients whose jaundice appeared later presented the same findings at operation with those that were found in the patients who were jaundiced in the first weeks of life. The youngest of these five patients was operated on at the age of two and one-half years and the oldest at five years. The operation of cholecystoduodenostomy was performed on three of the patients and that of choledochoduodenostomy on two. There was no mortality in this group which has been followed for periods of one month to 15 years. Though there was no mortality in the group the results have not been entirely satisfactory. The patient who has been followed the longest, namely 15 years, has mild attacks of jaundice from time to time. None of the other four who have been followed for periods of seven years, five years, four months, and one month respectively have had any recurrence of their jaundice. They have had occasional attacks of mild abdominal pain or discomfort. One patient on whom a choledochoduodenostomy was performed has had no recurrence of jaundice and the pain referred to has been so slight and so fleeting as to hardly warrant comment. The other patient on whom choledochoduodenostomy was performed was followed too short a time to justify definite conclusions, but both suggest that the operation of choledochoduodenostomy is preferable to that of cholecystoduodenostomy.

#### CONCLUSIONS

Obstruction of the bile ducts due to congenital malformation is certainly common enough to warrant more attention in the future than it has received in the past.

The diagnosis can be made by a process of elimination with great certainty by the end of the second month of life, and usually a little earlier. When the diagnosis has been made, exploratory operation should be recommended. The mortality of the patients with complete obstruction without operation is obviously 100 per cent. In this series of 45 cases, there were 40 cases with complete obstruction. Of these 40 cases, 15 were theoretically amenable to relief

by surgical methods. In other words, 37 per cent of the cases present possibilities of cure. Nine patients or 60 per cent of the operable patients with complete obstruction have recovered, and have been followed for periods of time ranging from ten years down to six months. They have remained free of jaundice, and developed normally. From this experience, it seems justifiable to conclude that the liver has sufficient regenerative power to overcome the fibrosis which was observed at the time of operation. It likewise seems reasonable to believe that the idea that these patients are going to die of this cirrhosis even after the obstruction has been relieved is unwarranted. The operation should be done before the fourth month of life because the patients are prone to suffer fatal complications after that age. The group in this series having partial obstruction have had no mortality. In this group, the late results suggest that the operation of choledochoduodenostomy is preferable to that of cholecystoduodenostomy.

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## STENOSIS OF THE BILE DUCTS BY CONTIGUOUS CICATRICAL TISSUE

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STENOSIS usually connotes a narrowing of either extremity of a canal or of an intervening segment the result of some inherent lesion. The fact that the title of this paper refers to the canals in question—namely, the bile ducts—as normal, ought to prevent misunderstanding. Perhaps obstruction in place of a stenosis would be preferable.

Strictly speaking, in two cases herewith reported, the bile ducts were not normal. Thus in Case VI some thickening of the wall of the common duct underlying the adhesion was found, and in Case VIII the middle of the common duct was considerably dilated and somewhat thickened by adhesion. In both instances the thickening was evidently limited to the outer wall of the duct, representing the extension of the contiguous cicatricial tissue. A similar condition is frequently observed in other abdominal viscera adherent to some primary infectious process. Inspection of the mucous membrane of the divided duct can alone determine the presence of some pathologic change. Such an opportunity was afforded in Case VII; no mention being made of any lesion in the lining membrane of the duct. In this and all other reported cases the relief of symptoms and the absence of recurrence seem to justify the conclusion that the ducts were essentially normal.

Jaundice due to the pressure on the normal hepatic or common ducts by some extraneous lesion is not uncommon. It may follow the pressure of lymphatic glands at the hilus of the liver, involved in ordinary inflammation or of those invaded by tuberculosis or carcinoma, the pressure of cysts in the kidney or liver, including those due to the echinococcus; by the pressure of the gravid uterus; or the blocking of the duct with the ascarides. The closure of the duct of *Wirsung* by the pressure of malignant growths in the head of the pancreas is not infrequent. While the common duct cannot be regarded as normal in the two cases reported by Herfarth,<sup>1</sup> their great interest and rarity justify their mention at this time. In one, on autopsy several days after operation, the jaundice was found to have resulted from the invagination of the end of the duct into the duodenum, a transverse fold of its mucous membrane passing over and effectively closing its orifice. In the other, also on autopsy four days after an operation, jaundice had followed occlusion of the terminal duct through pressure on its orifice by a prolapse of its mucous membrane, projecting nipple-like into the lumen of the duodenum. The ages of the patients were 51 and 53 respectively, and in both cases some form of neoplasm was the preoperative diagnosis.

The present paper is not concerned with the different varieties of jaundice which have just been enumerated, but is restricted solely to the consideration



of stenosis of a normal biliary passage through the action of contiguous cicatricial tissue. If occlusion of the cystic duct alone results jaundice is not present. When the hepatic duct or common duct is involved, jaundice is constant and progressive.

While usually the formation of such adventitious tissue follows operation, it may, in the absence of operation, reflect the effort of the overlying peritoneum to protect the abdominal cavity against threatened perforation of the wall of some hollow viscus and, when so formed, such tissue may persist indefinitely, long after the infectious process, of which it originally was a part, has completely disappeared. Exceptionally in the upper right quadrant as in other parts of the abdominal cavity, bands or masses of connective tissue may form without the positive history of some previous infectious process. In one such instance in which abdominal discomfort had existed for many years and in which gastric stasis was relieved only by repeated daily lavage, the pylorus, hepatic flexure and gallbladder were found on operation completely invested in a mass of dense connective tissue. The pylorus was so sharply angulated and firmly attached to the under surface of the liver that only small quantities of gastric contents could pass into the upper intestine. Sharp dissection was necessary to restore the structures in the gastrohepatic omentum to their normal relation and to enucleate the gallbladder, entirely buried in the mass of connective tissue. No scars were found in the wall of either the pylorus or duodenum, indicative of previous ulceration and both the gallbladder and ducts were normal. Jaundice had never occurred notwithstanding the extensive pathology in and about the gastrohepatic omentum.

Peritoneal adhesions consisting of organized connective tissue either with or without previous abdominal operation vary in density and extent. In the upper right quadrant, especially after operation, they may be of almost cartilaginous consistency, and usually the anterior edge of the liver, the gallbladder, if present, the pylorus and first part of the duodenum, and the hepatic flexure are more or less firmly bound together in a mass of adherent great omentum. While no actual proof can be adduced and experienced pathologists may not concur, more dense and extensive adhesions seem to be encountered in the right upper quadrant than in the other segments of the peritoneal cavity. Especially subsequent to cholecystectomy or other operations on the biliary tract in which drainage has been extensive and protracted, these adhesions become organized into cicatricial tissue which, as it contracts distorts, constricts, or displaces those structures to which it may be attached. Angulation of the bile ducts, when these structures are distorted, no matter how slightly, may easily result in obstruction which it is difficult for the pressure of the bile current, which normally does not exceed four Mm., to overcome. Such angulation, following cholecystostomy, has been reported in an excellent essay by Stetten,<sup>3, 4</sup> due to a postoperative shrinkage of the gallbladder. The consequent pain and discomfort, without jaundice, however, were relieved by a cholecystectomy. Apart from angulation or distortion of the duct, the presence of a biliary fistula is an important factor

in causing an almost complete absence of pressure in that portion of the duct between the orifice of the fistula and the intestine which, as long as the fistula persists, presents no resistance to any force of pressure or constriction to which it may be subjected. The result of angulation of the common duct is well illustrated in a case reported by Ransom,<sup>2</sup> in which, some weeks after a cholecystectomy, an attachment by cicatricial tissue of the divided end of the cystic duct to the under surface of the liver produced such an acute angle in the long axis of the common duct that persistent jaundice developed. The liberation of the cystic stump by the excision of the adherent tissue restored the normal axis of the common duct and permanently relieved the jaundice.

Perhaps it is well to emphasize at the risk of repetition that, because of the constant low pressure of the bile current, surprisingly slight degrees of obstruction may result in jaundice. In discussing this fact Doctor Rohdenburg, pathologist to the Lenox Hill Hospital, related a case, the history of which follows in which pinkish masses of apparently lymphatic tissue surrounding the end of the common duct and overlying one another in a somewhat spiral fashion, were found to have been the cause of the obstructive jaundice. He is of the opinion that a small probe should normally pass by its own weight through the papilla into the duodenum, provided it does not catch in a fold of mucous membrane. In the present case, on autopsy, such a probe passed through the papilla only with gentle pressure.

A female, aged 62, admitted to the hospital five months previous with jaundice. Operated upon and gallbladder with stones removed, drained. The common duct found patent at the time of operation. A fistula draining bile persisted for a time. The fistula closed and the patient became jaundiced. The fistula opened and the jaundice disappeared. This was repeated three times. She was discharged from the hospital with the fistula closed and slight jaundice one week before her death. She was readmitted with a right lower pneumonia from which she died seven days later. During her second stay in the hospital the fistula remained closed and the jaundice slowly became deeper. Death from cardiac failure.

*Autopsy.*—The region of the gallbladder is found to be a dense scar which is adherent to the overlying musculature and matting together the adjacent loops of the gastrointestinal tract. The liver is slightly enlarged, weighing 1,800 Gm., and is jaundiced. The usual markings are somewhat obscure. The liver and adherent intestinal canal is removed *in situ* and carefully dissected. The gut is opened and the duodenum identified. The ampulla of Vater is identified. The common bile duct is found. It does not appear to be dilated, measuring in the unopened state four cm. in cross section. Where the common duct enters the intestine and on the serous surface of the gut are found pinkish masses, apparently lymph nodes, which surround the common duct and which overlay one another in a somewhat spiral fashion. Upon opening the common duct at a distance from the intestine a four inch probe was easily passed into the intestine. Upon holding the liver up, the gut being suspended, the probe being in place, the probe did not fall into the gut through the ampulla.

The clinical records of the cases herewith reported are conveniently divided into two groups: A—Those in which no previous operation has been performed. B—Those in which such an operation has taken place.

## STENOSIS OF BILE DUCTS

GROUP A.—CASE I.—(Courtesy of Doctor Amendola). Multiple strictures of the cystic duct, due to adhesions from an old duodenal ulcer; marked cholecystitis without calculi. Distended gallbladder could be emptied only after division of adhesions. Cholecystectomy.

Male, aged 50. Treated previously for 15 years for duodenal ulcer with persistent ulcer defect. For past two years there have been symptoms suggesting gallbladder trouble without jaundice. The Graham test showed no change in emptying and no diminution in the concentration of the bile. Operation for the biliary condition. Through a pararectal incision the gallbladder was found to be distended and the site of a chronic cholecystitis. The cystic duct was angulated in several directions by adhesions which had extended upward from an old healed ulcer in the first part of the duodenum. As soon as these adhesions were divided the gallbladder could be easily emptied. The common duct was normal. A cholecystectomy was done.

CASE II.—(Courtesy of Dr. C. W. Cutler, Jr.). Adhesions about the ampulla of the gallbladder and around the cystic and common ducts from an old healed duodenal ulcer to the site of which the fundus and mid portion of the gallbladder were densely adherent. No calculi. Constriction relieved. Gallbladder not removed.

Male, aged 37. Chief complaint, right upper abdominal pain and indigestion. For three or four years the patient has suffered from indigestion, belching of gas associated with discomfort in the epigastrium and the right upper quadrant. There has been no definite relation of this pain to meals. Five days before admission there was a severe attack of right upper quadrant pain extending into the epigastrium. This pain was colicky in character and intermittent. It occurred in attacks of two or three hours' duration and was quite severe. The patient did not vomit. There was a similar attack two years ago.

Physical examination showed no masses, tenderness or spasm. Roentgen ray revealed a well visualized gallbladder which was, however, distinctly distorted about its mid portion. The stomach showed constant deformity of the duodenal cap with hypermotility and no retention.

At operation, the gallbladder in its fundus and mid portion was densely adherent to the first part of the duodenum by a thick short band of adhesions about one cm. in diameter and less than one cm. in length. The gallbladder wall about this adhesion was thickened. Upon freeing the gallbladder from the duodenum, the site of the adhesion was found to be the center of a puckered indurated area representing an old healed duodenal ulcer. There were also some adhesions about the ampulla of the gallbladder and around the cystic and common ducts. These constrictions were relieved. No stones were found. The gallbladder was not removed. A tab of fat from the mesentery was sutured across to cover the area of the former adhesions to the duodenum. Uninterrupted convalescence.

CASE III.—(Courtesy of Dr. C. W. Cutler, Jr.). Male, aged 31. Adhesions extending to gallbladder, cystic and common ducts from an old duodenal ulcer close to the pylorus with the history of one attack of jaundice. Symptoms permanently relieved by posterior gastro-enterostomy.

Chief complaint, pain in the right upper quadrant, recurring attacks of dyspepsia for 20 years. Several years ago the patient had an attack of typhoid fever of six weeks' duration. Some time afterward he suffered his first attack of right upper quadrant pain which was followed in several days by jaundice. Vomiting accompanied the attack. For several weeks afterward there was slight pain in the right upper quadrant. Since then he has had several similar attacks but without jaundice. Recently the pain has become more severe. There has been some relation of the pain to meals occurring one hour afterward, relieved by soda. A good deal of belching and feeling of distention. During the periods of remission he has felt perfectly well. Has noticed dark stools occasionally. No loss of weight.

Physical examination revealed tenderness in the right upper quadrant, no palpable mass but a sense of fullness. Roentgen ray showed evidence of duodenal ulcer.

On operation the gallbladder was found adherent to the duodenum. In the duodenum was an old constricting ulcer close to the pylorus with adhesions extending to the gallbladder, the cystic and common ducts. A posterior gastro-enterostomy was done. Recovery satisfactory.

CASE IV.—(Courtesy of Dr. R. H. Patterson). Female, aged 26. Constriction of the supraduodenal portion of the common duct to one fifth of its caliber by a band of fibrous tissue extending from the first part of the duodenum to a shriveled and puckered gastrohepatic omentum, containing a good sized branch of the gastroduodenal artery. Intermittent jaundice. After the division of the band and the ligation of the artery the caliber of the duct became normal and bile readily passed into the intestine. During the past two years patient has had intermittent attacks of pain in the right upper quadrant often associated with jaundice. The pain has never been agonizing nor the jaundice severe. Gallbladder and G. I. series negative. Lyons drainage has failed to yield any "B" bile. Otherwise essentially negative.

On operation through right rectus splitting incision, the gastrohepatic omentum was very short and puckered up, bringing the pylorus and the first part of the duodenum much closer than usual to the gallbladder. From the upper border of the first part of the duodenum a fibrous band, containing an artery, extended to and encircled the right lateral and posterior aspects of the lower third of the common duct in such a way as to rotate or twist or constrict the duct until it was not more than one-quarter or one-fifth of its normal diameter. When the gallbladder was compressed it would not empty.

The peritoneum covering the gastrohepatic omentum was divided transversely and the vessels and duct straightened out considerably. The fibrous band and its artery were then ligated and divided. The duct then returned nearly to its normal diameter and pressure easily emptied the gallbladder. The patient made an excellent recovery and, now, at the end of two years, there has been no sign of recurrence.

GROUP B.—CASE V.—(Courtesy of Dr. C. W. Cutler, Jr.). Female, aged 62. Five months previous to the present illness a cholecystectomy was performed. For past three weeks pain in the right upper quadrant with gradual increasing jaundice. On operation there were numerous extensive adhesions between liver, omentum and duodenum. Adhesions divided. No stone in the common duct. Moderate chronic infiltration of the pancreas. Death from cardiac failure four days later.

CASE VI.—(Courtesy of Dr. C. W. Cutler, Jr.). Male, aged 73. Ten years ago a cholecystectomy. For past three weeks pain in the right upper quadrant with increasing jaundice. On operation adhesions constricting the common duct with some thickening of its wall underlying the adhesions were found. Adhesions divided. No stone in the common duct. Discharged in good condition four weeks after operation.

CASE VII.—(Courtesy of Dr. C. W. Cutler, Jr.). Female, aged 49. One year ago cholecystectomy and choledochotomy for calculi. For past week nausea, vomiting, epigastric pain, and jaundice. Common duct found greatly dilated and kinked at its lower end where it was adherent to the superior surface of the duodenum. Pancreas soft. Common duct freed and drained. Recovery.

CASE VIII.—(Courtesy of Dr. DeWitt Stetten). Female, aged 41. Cholecystectomy in 1920. Four years later severe pain in the epigastrium (requiring morphine) with vomiting and jaundice. On operation extensive adhesions (not very dense) between omentum, ascending colon, hepatic flexure of the colon and loose coils of ileum to the anterior abdominal wall, and to the under surface of the liver. The duodenum was adherent through dense adhesions to the under surface of the liver near the transverse fissure, causing marked angulation of its axis. The middle of the common duct was considerably dilated and somewhat thickened by adhesions. No calculi were found.

## STENOSIS OF BILE DUCTS

There was marked induration of the pancreas. All adhesions were freed. The duct was not opened. Recovery satisfactory. No recurrence.

### PERSONAL CASES

CASE IX.—Female, aged 52. Cholecystectomy in 1905 for biliary calculi. At that time the ducts were normal. Nine months later pain developed in the right upper quadrant with gradually increasing jaundice. At operation dense adhesions between the liver, the hepatic flexure, pylorus and omentum were found, kinking the common duct. The adhesions were freed and the abdomen closed without drainage. The jaundice disappeared and the patient remained well for 18 years when death due to apoplexy occurred.

CASE X.—Male, aged 56. Eight years before present illness cholecystectomy for gallstones. Five weeks ago jaundice appeared without pain and has steadily deepened. In the last few months he has lost 20 pounds in weight. On operation firm and dense adhesions between the liver, stomach, duodenum, the hepatic flexure and omentum were found. By sharp dissection these adhesions were gradually divided until the gastrohepatic omentum was exposed. The vessels and duct, the latter without calculi, were restored to their normal relations. Normal bile was withdrawn through a fine needle from the interior of the duct. The head of the pancreas was thick and firm without any distinct new growth. A small overlying lymphatic gland removed for microscopic examination, showed ordinary inflammatory changes. Closure without drainage. The jaundice disappeared entirely within six weeks. The patient regained the lost weight, and has remained well up to the present time, two and one-half years since the operation.

That contraction of cicatricial tissue completely investing the hepatic or common duct ought eventually to obstruct the flow of bile is quite conceivable. In that event the simultaneous inclusion of the adjacent portal vein and its subjection to the same constricting force might logically be expected. The fact, however, that that important vessel is rarely sufficiently constricted to disturb the portal circulation or to result in ascites, justifies the conclusion that the obstructive jaundice in these cases is ordinarily due to angulation or distortion rather than to annular constriction of the duct. As a matter of fact the actual cause of obstruction can rarely be demonstrated in the course of the operation for its relief, for the offending tissue must be divided, not infrequently by sharp dissection, in order to restore the gastrohepatic omentum and its contents to their approximately normal relations.

Furthermore, consideration of the anatomic and physiologic features of the duct and vein may account, in part at least, for the rarity of obstruction to the portal circulation irrespective of the character and extent of the cicatricial tissue. Thus, the diameter of the lumen of the portal vein is twice that of the duct. Its wall contains a large amount of longitudinal smooth muscle, abundant fibrous tissue, and a small amount of elastic tissue. In the relatively thin wall of the duct, there is a large amount of elastic tissue, scant longitudinal muscle fibers, and little fibrous tissue. The lumen of the duct is easily occluded by external pressure and may be completely occluded by an external annular cicatrix. Owing to its larger diameter and inelastic wall, such an annular cicatrix would merely pucker, without occluding the lumen of the vein. The relation of the hepatic artery to the portal vein is an important contributing factor to the relative immunity the vein enjoys in the occlusion of its lumen by the contraction of contiguous cicatricial tissue. In its



course from below upward the vein lies first on a posterior plane between the artery and the duct, as it approaches the transverse fissure of the liver it passes behind the artery and overlaps it internally, the distance between the duct and the vein gradually increasing. The artery is in fact a quasi-mechanical factor protecting the vein from encroachment by adhesions, while the intravenous pressure as well as the velocity of the blood within the vein by the transmission of the intra-arterial pressure are materially increased.

Although unable to find in surgical literature the report of the occlusion of either the normal duct or normal vein by cicatricial tissue, the cases just cited show conclusively that obstructive jaundice due to that cause is not rare. On the other hand, only one instance of obstruction to the flow of blood within the portal vein due to a similar cause is available.

CASE XI.—(Courtesy of Doctor Rohdenburg). Clinical history not found. Autopsy record: the gallbladder had been removed at a previous operation and the first and second parts of the duodenum are firmly attached to the inferior surface of the liver in the space originally occupied by the gallbladder. This mass of fibrous tissue is adherent to the adjacent lumbar vertebrae and the great vessels and is found constricting the portal vein. The latter shows no evidence of thrombosis. In this case there was extensive ascites but no jaundice. The liver showed a marked passive congestion.

In the following case the stenosis of the portal vein was probably only a contributing factor in the development of the ascites. The multiple infected thrombi in the portal radicals, together with the absence of congestion in the liver, the spleen and the alimentary canal justify that conclusion. The case has, however, marked pathologic interest for, as in Doctor Rohdenburg's case, it demonstrates the possibility of stenosis of the portal vein without involvement of the duct. In this, as well as in the preceding case, jaundice was absent.

CASE XII.—(Courtesy of Doctor Stetten). Female, aged 29. Cholecystectomy for a dilated and tense gallbladder without calculi. Convalescence marked by rapid pulse, and by some congestion over the bases of both lungs. There was also pain in the dorsolumbar region suggestive of renal calculi, but roentgen ray excluded both that lesion and any abnormality in the upper intestinal tract. Three months after the cholecystectomy, patient was readmitted to the hospital with abdominal discomfort and pain extending from the dorsolumbar region around to the pubis. Cystoscopy was negative.

On examination, the liver was found to be greatly increased in size and on two occasions considerable fluid was withdrawn from the abdominal cavity. After two months of observation in the medical ward the abdomen was explored. The stomach, duodenum, hepatic flexure and omentum were bound together by firm and very dense adhesions. As the transverse fissure of the liver was approached, these adhesions became almost of cartilaginous consistency. An effort was made to expose the portal vein without success. The liver was large and friable, the spleen of normal size and consistency. The patient did well for ten days and then suddenly developed a high temperature and rapid pulse and shortly died in a condition of collapse. A partial examination made through the operative wound showed stenosis of the portal vein by the cartilaginous tissue at the transverse fissure of the liver without thrombus formation. Sections of the liver and kidney showed the presence of a large number of infected thrombi of which mention has previously been made.

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It is important to emphasize that the clinical histories of these cases of duct obstruction vary considerably. This is particularly true of the associated pain and jaundice. The former symptom, usually present and generally referred to the upper right quadrant, may be referred to the "pit of the stomach" or to the epigastric region. It may be localized or diffuse, so severe as to require morphine, or may be only a sense of discomfort. In Case X there was no pain at any time and that fact, together with the noticeable loss of weight in a patient over 50, suggested a malignant condition. The variation in the type and location of this symptom is also observed in the more common lesions of the biliary tract. Not infrequently calculi in the common duct are painless or are absent when the pain is severe. Jaundice also varies. It may be intermittent, or constant and progressive. It may be due to inflammation of the mucous membrane of the duct and not to stenosis.

While division of excision of the offending cicatricial tissue ordinarily affords relief, which in several of the cases cited continued for years without any indication of recurrence, reformation of similar adhesions with stenosis or distortion of the duct is not impossible. Should it occur, operation is of course again indicated.

Great appreciation is expressed to Doctors Amendola and Cutler of Roosevelt Hospital; Doctor Patterson of Bellevue Hospital; Doctors Rohdenburg and Stetten of the Lenox Hill Hospital; and to Doctors Prewitt and Helfrick of the Knickerbocker Hospital for their kind cooperation and assistance.

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DISCUSSION.—DR. DANIEL F. JONES (Boston, Mass.).—After considering some 2,000 operations I could not find any case in which the condition found in these cases was present. Our pathologist told me that he knew of one case of obstruction to the common duct due to a tuberculous node, which condition Doctor Eliot has not considered.

It seems to me that these cases fall into two groups. The first group includes the obstructions to the cystic duct, while the second includes kinks or bands obstructing the common duct. In the first group it is quite easy to see that the cystic duct is freely movable and therefore might be obstructed by a band which pulled upon it enough to obstruct it, but this must be very unusual.

The condition in the second group, obstruction to the common duct by bands or adhesions, would seem impossible so long as the duct is covered by peritoneum. A band attached to the peritoneum over the duct could not, I believe, kink the duct. It might be possible in drained cases to have the stump of the cystic duct become adherent to a gauze drain, and one can imagine the stump of the duct being so pulled upon when the drain is removed that the common duct is kinked and the kink maintained by the cystic duct which becomes adherent in this abnormal position. An inflammatory process about the common duct, if it is covered by peritoneum, will I believe never cause obstruction. If the peritoneum is destroyed and the inflammatory

process of long standing, it is probably possible for it to cause obstruction.

The importance of this communication, it seems to me, is to bring out the fact that the common duct may be partially obstructed when left uncovered, and that the duct should always be covered with peritoneum after it has been exposed. Care must also be used to prevent the wick becoming adherent to the stump of the cystic duct as it might be pulled up sufficiently to kink the common duct. I have, however, been unable to find any such case. I could find no case in which an adhesion or any inflammatory process outside the duct, except in the pancreas, had caused obstruction to the common duct.

DR. CONDUCT W. CUTLER (New York).—We are indebted to Doctor Eliot for presenting, in this paper, a feature of real though perhaps previously underestimated importance in the pathology of the biliary tract. In his cases, described in Group B, representing instances of constriction of the bile passages by adhesions following operation on the gallbladder we are reminded of a possible late complication of cholecystectomy. It seems reasonable to suppose that some of the right upper quadrant pain and epigastric distress to which patients, who have had a cholecystectomy, are occasionally subject, may be explained by the presence of such constricting or distorting adhesions as he has described. Fortunately, in most instances the viscera adjust or accommodate themselves to the situation and the symptoms abate after a time. In comparatively few the condition persists to the point where further surgery is required as in the cases cited.

It would seem important to consider means of minimizing the formation of such adhesions. This brings into practical consideration the matter of peritonealizing of the gallbladder bed, the question of drainage after cholecystectomy, and of care in the protection and packing off of neighboring viscera and in their handling during the operation. In recent cholecystectomies at the Roosevelt Hospital I have used rubber dam, as suggested by Lilienthal, for packing off the field, as being less traumatizing to peritoneum than gauze pads.

In Doctor Eliot's Group A cases we have an interesting illustration of distortions of the biliary tract by adhesions from pathology in neighboring structures. These distortions are truly pathologic and productive of symptoms, and are not to be confused with such anatomic and congenital anomalies as have been recently described by Boyden.<sup>1</sup> The roentgenograms of the two conditions are much alike. These anomalous distortions of the fundus and body of the gallbladder, which have also been described by Barsony and other German writers, were found by Boyden to be present in four per cent of 165 cases examined. Buedinger<sup>2</sup> has grouped these congenital anomalies and the pathologic distortions together in his description of cholecystitis mechanica. It would seem well to recognize the distinction as of importance from the therapeutic point of view.

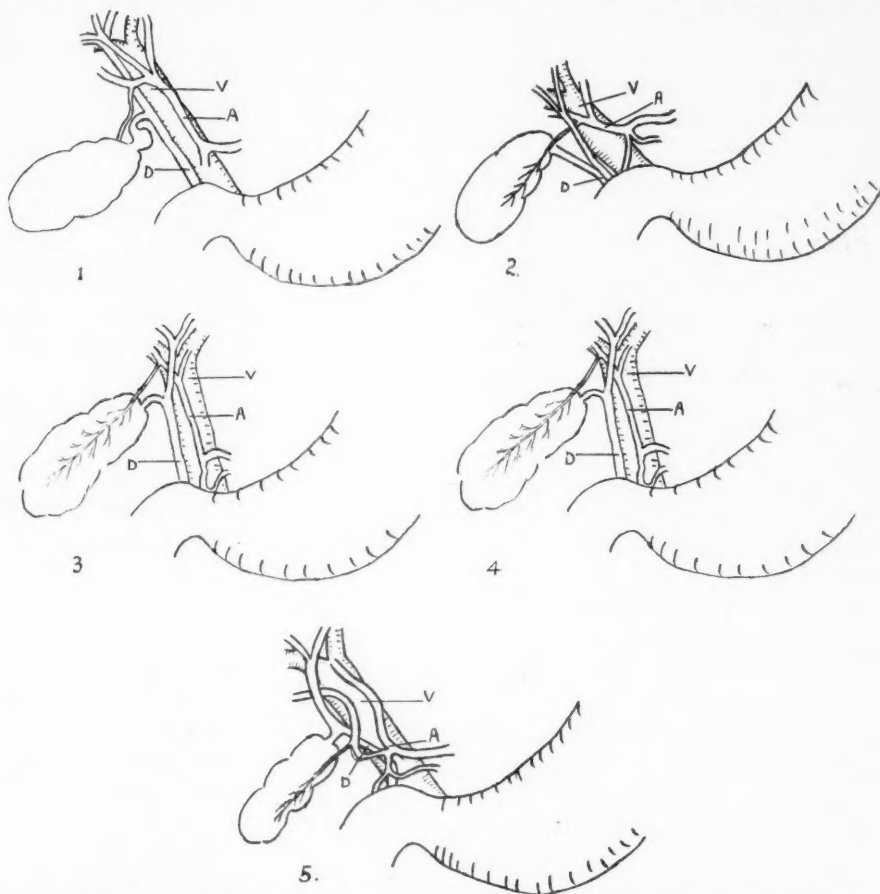
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DR. ELLSWORTH ELIOT (New York).—I am very much indebted to both Doctor Jones and Doctor Cutler for the discussions they have contributed. I regret very much that Doctor Cave, who had also promised to dis-

## STENOSIS OF BILE DUCTS

cuss the paper, was called back to New York. He would have emphasized the fact, which I also venture to emphasize, that the excision of the cicatricial tissue only will not always relieve the patient. He intended to report a case in which the cicatricial tissue was so dense that an anastomosis between the dilated duct above the cicatricial tissue and the duodenum was necessary. This anastomosis was performed with a Murphy button. The patient made an excellent recovery and, four years after that operation has had no recurrence. Doctor Cave was also to report a case following a cholecystectomy in which the cicatricial tissue was removed in the way which has been cited



Doctor Helfrick's sketches, showing relation of hepatic artery, portal vein, hepatic and common duct.

in the paper, with an equally satisfactory result, the recovery extending five years after the operation without recurrence.

As to the frequency of this condition, I think it is rather of interest to call attention to the fact that I was unable to obtain a report of a single case from members of this Association in Cleveland, Boston, Philadelphia, Baltimore, Rochester, and one or two other centers, nor from several colleagues in New York whose experience in the surgery of the gall ducts has been very extensive.

I wish also to emphasize the necessity in this condition, mentioned by Doctor Jones, of careful, gentle handling, and by Doctor Cutler, the advisa-

bility of the use of the rubber pad, and by Doctor Cave, were he present, the interposition of the omentum between the under surface of the liver and the upper surface of the duodenum, all measures which may possibly restrict the formation of cicatricial tissue and so diminish the frequency of this condition.

The following five slides made from sketches in the course of autopsies, without previous injection of the vascular channels and ducts, there by preserving the normal relation of these structures, in patients with normal abdominal cavities who had died from the effects of severe trauma. For their preparation I am indebted to my intern Dr. R. Helfrick at the Knickerbocker Hospital. In all of them, A designates the hepatic artery; B the portal vein; and D the common duct. They illustrate both the normal relation and the not infrequent variations of the hepatic artery and its branches and require no detailed description. All show the tendency for the vein to pass behind and to the mesial side of the artery as it approaches the liver, diverging slightly from the duct, as it ascends along its side.



## TREATMENT OF CARCINOMA OF THE AMPULLA OF VATER

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A DEFINITE advance has been made in the last five or six years in the surgery of the pancreas, notably in the brilliant cures of hyperinsulinism by the removal of adenomata and more recently by the excision of a large part of the pancreas itself. These cures have been reported by American surgeons with no mortality in the series thus far published.

Because of a technique used in successful operations on a number of adenomata, cyst-adenomata and benign cysts of the pancreas, we became interested again in attacking the problem of malignancy of the pancreas and peri-ampullar region. The fact that a large part of the pancreas can be safely excised, and that in animals the main ducts can be ligated as they enter the duodenum without permanent damage to their well being, suggested a new approach to the problem. This was impressed upon us after an unsuccessful attempt to remove a carcinoma of the ampulla of Vater by the transduodenal method.

Involved in the previous attempts at radical removal of carcinoma of the papilla of Vater and the head of the pancreas are certain factors which have compromised its success and made it such a hazardous procedure as to be prohibitive in the minds of even the ablest surgeons. The first of these was the mistaken belief that the flow of pancreatic juice is essential to life, which led surgeons to attempt to reestablish this flow into the duodenum or jejunum by implanting the resected head of the pancreas or the cut end of the duct into the upper intestine. The activation of the pancreatic ferments by duodenal contents compromised any type of anastomosis in the human subject, especially around the posterior aspect of the duodenum devoid of peritoneum. Experimentally the operation of pancreato-enterostomy has been done successfully in dogs by Sauv  ,<sup>1</sup> Coffey,<sup>2</sup> and Sweet.<sup>3</sup> However, in dogs the pancreas is mobile and covered by peritoneum, quite in contrast to man. There are four case reports in the literature (Halsted, Hirschel, Kausch, Tenani<sup>4</sup>) in which this operation of reimplantation of the head of the pancreas or the duct was successfully carried out after a resection of the carcinoma of the ampulla. Two others reported by Koerte and Mayo-Robson died following this procedure. Our patient operated upon in this manner died from leakage around the anastomosis. We can form no idea of the number of unpublished cases in which it has been tried and resulted fatally, but it has seemed to us, because of the digestive action of the pancreatic ferments, that the hazard of this operation is too great to be advocated.

The second factor was the attempt to carry out the excision of these

tumors in one stage, whatever the method used. The victims of these tumors are as a rule deeply jaundiced, have a hemorrhagic diathesis, are depleted, undernourished, asthenic, and have severe liver damage. The majority of these patients cannot survive such a major operation until the associated conditions have been relieved. This factor has been recognized in recent years, and a preliminary short-circuiting operation to relieve jaundice has been carried out.

As a result of mistakes which were made in operating on our first two cases we arrived at a technic for radical removal for carcinoma of the papilla or the peri-ampullar region embodying the following principles:

1—That after resecting the descending limb of the duodenum with the pancreas wide of the growth no attempt should be made to reestablish the continuity of the duodenum or of the pancreas with the intestine.

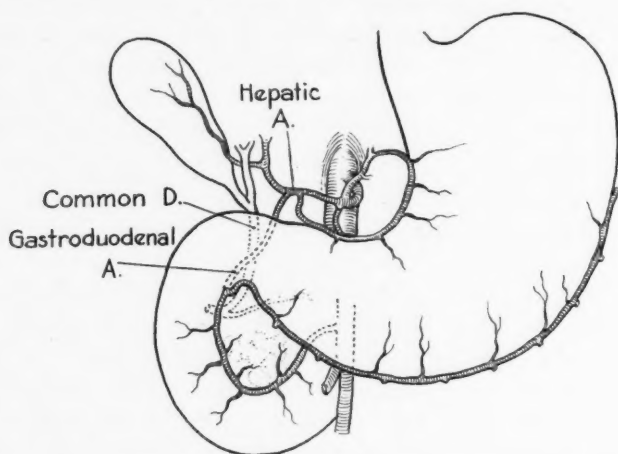


FIG. 1.—Normal anatomy of biliary tract and vessels in the operative field.

2—That the operation be a two stage one with definite steps in each stage and with the following technic:

(a) Spinal pantocaine anesthesia.

(b) A right rectus or epigastric midline incision for the first stage, with the following steps:

(1) Posterior gastro-enterostomy.

(2) Ligation and section of the common duct below the cystic duct after determining the patency of the cystic duct, and leaving a long black silk ligature as an indicator on the lower stump of the sectioned common duct. The great difficulty in finding the unsectioned duct in our first case and in dividing it at a sufficiently high level impelled us to divide the duct at the first procedure and to mark it with a clear signal.

(3) A cholecystgastrostomy to the anterior surface of the stomach well away from the pylorus, using an anastomotic opening at least 2 cm. in diameter, in order to avoid subsequent stenosis and cholangitis.

3—Three to four weeks after the first stage the second procedure is carried

# CARCINOMA OF AMPULLA OF VATER

out through a transverse incision above the umbilicus through both recti, if necessary, under spinal anesthesia. The steps in this second stage are as follows:

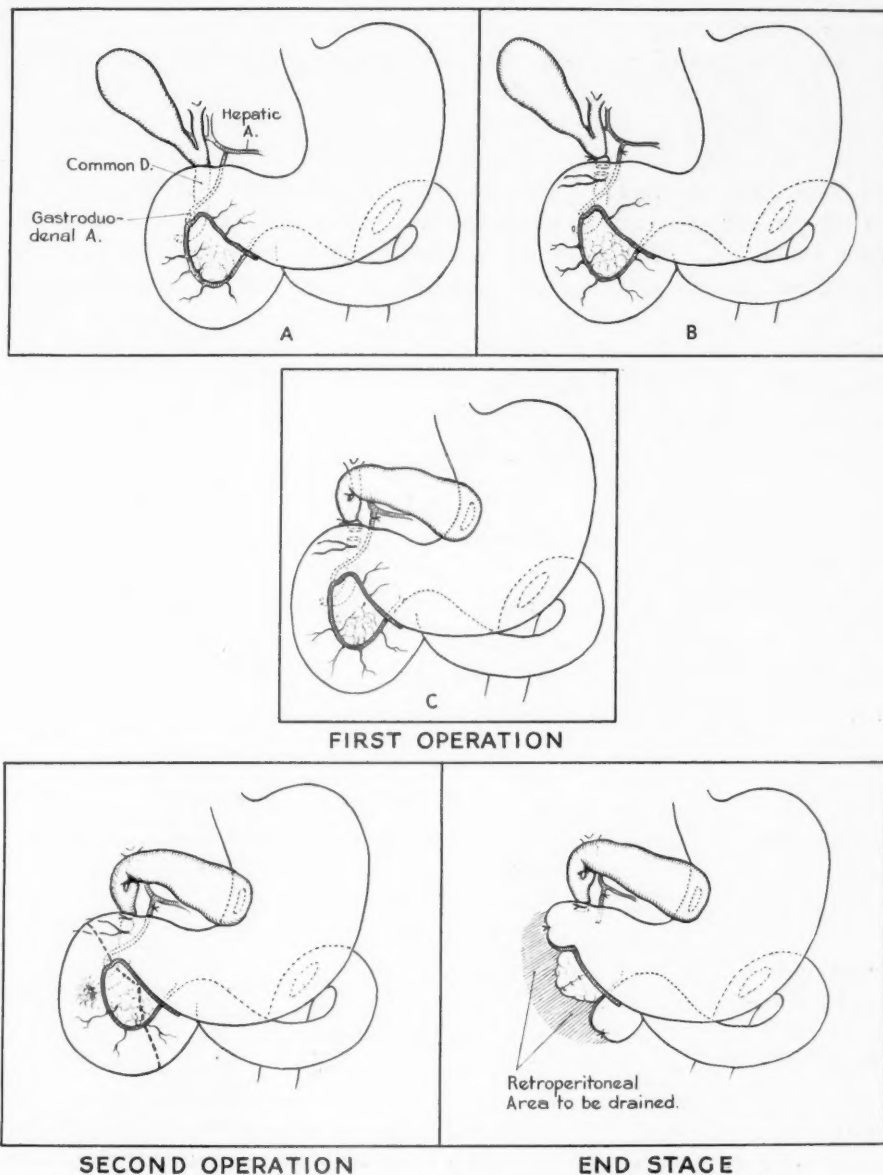


FIG. 2.—Consecutive steps in the two stages of the operation.

- (a) Ligation of the pancreaticoduodenal and gastroduodenal arteries.
- (b) Resection of the descending portion of the duodenum with inversion of the upper and lower ends, and a V-shaped excision of the head of the pan-

creas wide of the growth together with the common duct, using the silk ligatures as a guide to the lower cut end of the duct.

(c) A ligation of the cut end of the duct of Wirsung—and the duct of Santorini, if present—and the suturing of the two cut surfaces with interrupted fine silk.

(d) Drainage of the bed of the resected duodenum with cigarette drain.

4—Silk technic for both the first and second stages of the operation, using the finest silk for all but the large arteries.

We report the three cases subjected to radical removal of carcinoma of the papilla of Vater. The literature on the operative treatment of carcinoma of the peri-ampullar region of the duodenum was completely summarized by Cohen and Colp<sup>4</sup> in 1927. Shorter reviews have also been published by Fulde<sup>5</sup> and Lauwers.<sup>6</sup> Cohen and Colp were able to collect 59 cases treated by radical operation—one was not excised, but had radium applied locally. Of these, 24 died following operation; 13 died of recurrence; one died nine months later of cholangitis; and 21 or 35.6 per cent survived the operation and lived for varying periods, Kelly's case being well after eight and a half years, and Koerte's case for 22 years.

TABLE I  
*Cases Reported from 1927 to 1935*

Year	Author	No. Cases	Age	Sex	Diagnosis	Operation	Result
1925	Homans	1	?	?	Carcinoma of ampulla	Transduodenal removal with cautery	Well after "several years"
1927	Fulde	1	46	M.	Carcinoma of ampulla	Transduodenal removal with reimplantation of common and pancreatic ducts	Well after 2 yrs.
1927	Clar (Pamperl)	1	?	?	Carcinoma of ampulla	Transduodenal removal with reimplantation of common and pancreatic ducts	Well at end of 5 yrs.
1928	Busch	1	53	M.	Carcinoma of ampulla	Transduodenal removal with reimplantation of common and pancreatic ducts	Well after 1 yr.
1928	Del Valle§	1	42	M.	Carcinoma of ampulla	Transduodenal removal, choledochotomy, cholecystectomy and appendectomy	Operative recovery
1929	Klinkert (7)	2	53	M.	Carcinoma of ampulla	1st stage: Cholecystjejunostomy. 2nd stage: Transduodenal removal and gastro-enterostomy	Died after 3 mos. with liver metastases
	Pollet's case (8)¶		?	?	Carcinoma of ampulla	1st stage: Cholecystjejunostomy. 2nd stage: Transduodenal removal with reimplantation of common and pancreatic ducts	Operative recovery
1930	Bengolea	1	37	F.	Carcinoma of ampulla	Excision through choledochotomy opening and drainage of common duct	Reoperation 3 mos. later for jaundice. Metastasis in local lymph node
1932	Walters	1	50	M.	Carcinoma of ampulla	Transduodenal removal of papilla and reimplantation of common duct into duodenum	Well after 2 mos.
1932	Judd*	1	38	M.	Carcinoma of ampulla	Transduodenal removal 6 wks. after cholecystostomy and choledochotomy	Recurrence. Lived over 2½ yrs.
1932	Pemberton*	1	44	M.	Carcinoma of ampulla	Transduodenal removal, choledochoduodenostomy, and reimplantation of pancreatic duct into duodenum	Recurrence. Lived 2½ yrs.

# CARCINOMA OF AMPULLA OF VATER

TABLE I (Continued)

Year	Author	No. Cases	Age	Sex	Diagnosis	Operation	Result
1933	Potter	1	57	F.	Carcinoma of ampulla	Transduodenal removal with reimplantation of common and pancreatic ducts into duodenum	Operative recovery.
1933	Cabott†	1	35	M.	Carcinoma of lower common duct	Resection of lower common duct with choledochoduodenostomy	Well for 8 yrs.
1933	Collert†	1	64	M.	Carcinoma of lower common duct	Resection of lower end of common duct	Postoperative death
1933	Lauwers	2	51	M.	Carcinoma of ampulla	Transduodenal removal with cautery. Cholecystjejunostomy	Well after 3 yrs. and 10 mos.
			52	M.	Carcinoma of ampulla	Transduodenal removal with cautery. Cholecystjejunostomy	Well after 9 mos.
1934	Santero	2	50	M.	Carcinoma of ampulla	Transduodenal removal	Both recurred soon
			72	F.	Carcinoma of ampulla	Transduodenal removal	
1935	Whipple	1	60	F.	Carcinoma of ampulla	1st stage: Choledochoduodenostomy and cholecystostomy. 2nd stage: Resection of ampulla and adjacent pancreas with pancreatoduodenostomy	Postoperative death from duodenal leakage
1935	Parsons	1	53	M.	Carcinoma of ampulla	1st stage: Cholecystgastrostomy. 2nd stage: Resection of duodenum and head of pancreas with closure of pancreatic stump. End-to-end suture of duodenum. 3rd op. gastro-enterostomy	Died in 8 mos. of cholangitis
1935	Whipple	1	49	M.	Carcinoma of ampulla	1st stage: Gastro-enterostomy, ligation and division of common duct, and cholecyst-gastrostomy. 2nd stage: Resection of duodenum and head of pancreas with closure of pancreatic stump	Well after 3 mos.
1935	Janes‡	1	?	M.	Carcinoma of ampulla	1st stage: Cholecystgastrostomy. 2nd stage: (3 wks. later) Resection of duodenum and adjacent pancreas, closure of pancreatic stump, ligation of common duct, and gastro-enterostomy	Postoperative death from pneumonia.

\* Reported by Walters.

† Reported by Potter.

‡ Personal communication.

§ Schofield's case not included—treated by radium (13).

§ Reported by Llambias, *et al.*

# Reported by Klinkert.

TABLE II  
All Reported Cases

Operation	No. Cases	One Stage	Died	Lived	Two Stage	Died	Lived
Transduodenal excision..	65	60	22	38	5	0	5
Resection of duodenum..	6	3	1	2	3	1	2
Retroduodenal excision..	3	3	1	2			
Resection of common duct	3	2	1	1	1	0	1
Resection of duodenum and pancreas with closure of pancreatic stump	3				3	1	2
Total.....	80	68	26 (38%)	43	12	2 (16.6%)	10
			767				



The reported cases since 1927 are listed in Table I, giving a total of 22 cases including the three here presented. In this group there were three postoperative deaths, and six are known to have had recurrence of the tumor. Thus out of a total of 80 cases, 28 or 35 per cent died an operative death, and 20 others, or 24.6 per cent, are known to have had recurrence. It is probable that many of the remaining 34 cases also died from cancer, since only a short follow up is available in the majority.

TABLE III  
*Presbyterian Hospital Cases with Autopsy*

Case	Age	Sex	Autopsy Diagnosis	Metastases
9747	82	M.	Carcinoma of ampullar region (probably common duct origin).....	0
9850	65	M.	Carcinoma of terminal common duct with invasion of pancreas and metastases to liver.....	+
10489	65	F.	Carcinoma of ampulla (probably common duct)....	0
11011	55	M.	Carcinoma of terminal common duct with extension to pancreas and microscopic metastasis to a local lymph node.....	+
10699	67	M.	Carcinoma of terminal common duct.....	0
10839	56	F.	Carcinoma of peri-ampullar region of duodenum....	0
11011	60	M.	Carcinoma of peri-ampullar region of duodenum....	0
Total—M. = 5.				
F. = 2.				
With metastases = 2.				
Without metastases = 5.				

#### CASE REPORTS

CASE I.—W. S. Unit History 70844. C. C.—Jaundice of ten weeks' duration. *Family History*.—Irrelevant. *Past History*.—Partial thyroidectomy for hyperthyroidism four years before. Patient had suffered from symptoms of epigastric fullness for seven years and a duodenal diverticulum had been demonstrated by roentgenogram.

*Present Illness*.—For ten weeks patient has noted progressive painless jaundice with anorexia, dark urine, occasional abdominal cramps and loss of ten pounds in weight.

*Physical Examination*.—A white female 60 years of age, deeply jaundiced. Temperature 101.4°; pulse 75; respirations, 20; blood pressure 130/85. The liver is palpable 4 cm. below the right costal margin and beneath this an indefinite mass which seems to be gallbladder. The physical examination is essentially negative otherwise.

*Laboratory Data*: Hemoglobin, 77 per cent; red blood cells, 3,670,000; white blood cells, 8,350,000 (64 per cent neutrophils). Sedimentation rate, 70 Mm. in one hour. Blood amylase, 13.4. Duodenal drainage—bile stained fluid obtained, showing no cholesterol crystals and containing pancreatic ferments. Roentgenogram of the abdomen showed no calcified shadows. Urine, bile stained. Serum bilirubin, 6.8 mg. per 100 cc.

*First Operation*.—March 16, 1934. Choledochoduodenostomy and cholecystostomy. *Pathology*.—The gallbladder was distended and a small mass in the region of the ampulla of Vater could be felt. *Procedure*.—As described. *Course*.—The patient did fairly well following operation, and the jaundice cleared. The drainage tract closed in the third week.

*Second Operation*.—May 7, 1934. Resection of ampulla of Vater and pancreaticoenterostomy. Resection of the duodenal wall in the ampullar region with part of the

## CARCINOMA OF AMPULLA OF VATER

adjacent pancreas and suture of pancreas into the duodenal wall defect. The distal common duct was not well visualized. Course.—The patient went rapidly down hill and died about 30 hours after operation.

*Pathologic Report.*—Adenocarcinoma of the ampulla of Vater, apparently arising from the duodenal mucosa. The ampullar opening was completely closed off. Autopsy.—Showed acute localized peritonitis with fat necrosis in the region of resection, with leakage from the lower end of the common duct. There were no metastases.

CASE II.—E. W. Unit history 422730. C. C.—Severe itching of skin and painless jaundice, of two months' duration. *Family History.*—Grandfather died of carcinoma of the stomach. *Past History.*—Usual childhood diseases. Malaria many years ago. "Blood poisoning" nine years ago following infected left elbow. Gonorrhoea ten years ago with treatment.

*Present Illness.*—First admission of a 53 year old Nova Scotian boat builder for itching and jaundice, two months' duration. Nausea, no vomiting. Appetite very poor,



FIG. 3.—Case I.—Low power photomicrograph showing carcinoma of ampulla of Vater with stenosis of the lumen.

unable to eat fatty foods. Clay colored stools. Loss of 20 pounds in the past three months.

*Physical Examination.*—Temperature, 100.2°; pulse, 98; respirations, 18; blood pressure, 104/60. Poorly developed and emaciated old man, who is intensely jaundiced. Eyes—sclerae jaundiced. Lungs clear. Abdomen—distended liver edge two fingers down. No spasm or tenderness.

*Laboratory Data.*—Blood amylase, 5.8. Serum bilirubin, 10.7 mg. per 100 cc. Wassermann, negative.

*First Operation.*—Cholecystgastrostomy. July 18, 1934. Pathology.—A moderate number of adhesions were present in the right upper quadrant. The gallbladder was thickened, pale, markedly distended, containing 300 cc. of café au lait bile. No stones were made out in the gallbladder or common duct. The head of the pancreas presented a firm enlargement, somewhat nodular in shape, firm in consistency, lying on the deep surface of the organ. It was too deep to warrant the removal of a specimen. No metastases were seen in the liver. Procedure.—15 cm. right upper rectus incision. Silk technic.

Procedure as described. Course.—Uneventful. Sutures out seventh day, retention sutures out twelfth day. Wound healed by primary union. Up fifteenth day. Discharged August 14, feeling very well, to return in about a week for second operation.

*Second Operation.*—Partial pancreatectomy. Partial duodenectomy. Duodenoduodenostomy. August 21, 1934. Pathology.—The stomach was adherent to the under surface of the liver, so that the cholecystgastrostomy could not be seen. The common duct was enlarged, being a full centimeter in diameter. There was a hard mass at the region of the papilla of Vater which apparently also involved the neighboring pancreas. At least, this area of the pancreas was thickened. There was a slight amount of free fluid in the upper peritoneal cavity. Procedure.—Transverse incision across upper abdomen. Procedure as described. Patient was transfused at the end of the operation.

*Pathologic Report.*—Diagnosis: carcinoma of papilla of Vater.

*Course.*—Persistent vomiting after this operation, approximately 2,000 cc. a day, with nothing by mouth, was a serious complication. An obstruction at the site of the du-

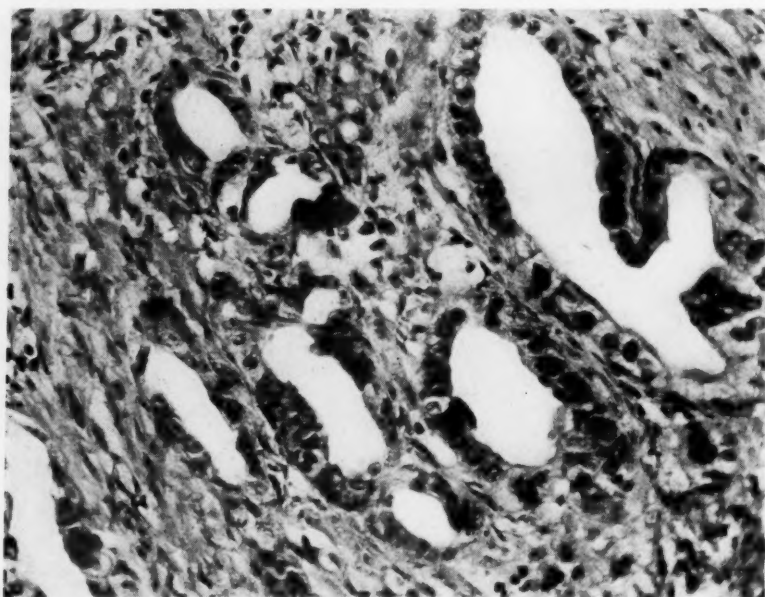


FIG. 4.—Case I.—Higher magnification showing the fairly well differentiated glands in the tumor.

odenoduodenostomy was thought to be the cause of this, so one week later a third operation was done.

*Third Operation.*—Anterior gastro-enterostomy. Entero-enterostomy. August 29, 1935. Pathology.—There was no free fluid. No evidence of fat necrosis. Area of previous operation not inspected. Procedure.—Fifteen cm. left upper rectus incision. Procedure as described. Silk technic. Course.—Patient had a very good recovery considering the severity of his previous operations. All wounds healed well. No leakage or drainage of pancreatic ferments. Following the pancreatectomy his blood amylase rose to 72 and then gradually fell to around 30. Blood sugar has been normal. Studies of his protein and fat digestion since operation show about an 80 per cent protein digestion and about 50 per cent fat.

Patient continued well until about March 4, when he began to have abdominal discomfort associated with head cold. Jaundice, light colored stools, dark urine, vomiting, for the past week. No itching. Chills and fever. He was readmitted March 25, 1935.

## CARCINOMA OF AMPULLA OF VATER

**Physical Examination.**—Skin dry and warm. Eyes—sclerae jaundiced. Lungs clear. Heart—sounds of good quality, no murmurs. Abdomen—incisional scars with herniation in central portion of epigastrium. Liver is felt 3 to 4 cm. below costal margin and is diffusely tender abdominally and on rib percussion. Abdomen soft and non-tender elsewhere, but moderately distended. Temperature, 104.6°; pulse, 100; respirations, 24; blood pressure, 140/85.

**Laboratory Data.**—Blood amylase, 11.4. Serum bilirubin, 8.2 mg. per 100 cc. Blood sugar, 1.30 Gm/L. Blood CO<sub>2</sub>, 49cc. per cent. Blood calcium, 7.4 mg. per 100 cc. Blood phosphorus, 1.7. Blood culture positive for *B. lactis aerogenes*. Course.—Patient ran a spiking temperature, 100°–104°, and gradually became weaker. He succumbed on April 18, 1935, three and one-half weeks after admission and approximately eight months after the radical operation.

**Autopsy.**—The peritoneal cavity contained about 500 cc. of yellowish fluid. There were firm adhesions between the stomach and the under surface of the liver. The spleen



FIG. 5.—Case II.—Low magnification indicating complete replacement of lumen of ampulla of Vater by tumor tissue.

was enlarged, weighing 320 Gm., and was of uniform red color. The liver weighed approximately 3,100 Gm., and contained numerous yellowish nodules varying in size from a few millimeters to 1½ cm. across. On section these contained purulent exudate. The hepatic ducts were dilated and the gallbladder also, the latter containing numerous soft yellowish stones and some sand-like material. The common duct was dilated, and at its lower end where it had been ligated there was a small amount of firm whitish tissue which microscopically showed carcinoma. There were no other areas of carcinoma found. The cholecystgastrostomy opening was contracted so that it admitted only a small probe. The pancreas was 12 cm. in length, with grayish-yellow lobules and abscess cavities scattered throughout the parenchyma. There were no connections between the pancreas and the intestinal tract. The pancreatic duct was moderately dilated. The remainder of the examination, including the chest cavity and the thyroid, showed nothing except multiple abscesses in the lungs and kidneys, the result of the septicemia. Microscopically the liver showed evidences of the marked infection with many abscesses. The portal areas showed some increase of connective tissue with inflammatory cells. There

was no fatty degeneration noted. The pancreas showed, in addition to the multiple abscesses, moderate fibrosis and atrophy of the acinar tissue.

It was the pathologist's opinion that the sequence leading to death was stenosis of the cholecystgastrostomy opening, with bile stasis, infection, septicemia and death.

CASE III.—M. J. Unit History 440080. C. C.—Itching and jaundice, and clay colored stools of two and one-half months' duration. *Family History*.—Negative. *Past History*.—Negative except for malaria 18 years ago, Gonorrhoea 20 years ago. Gas and belching p.c. for past 20 years.

*Present Illness*.—For past two and one-half months patient has had epigastric pain, colicky, and nausea and anorexia. No vomiting. This was followed two weeks later

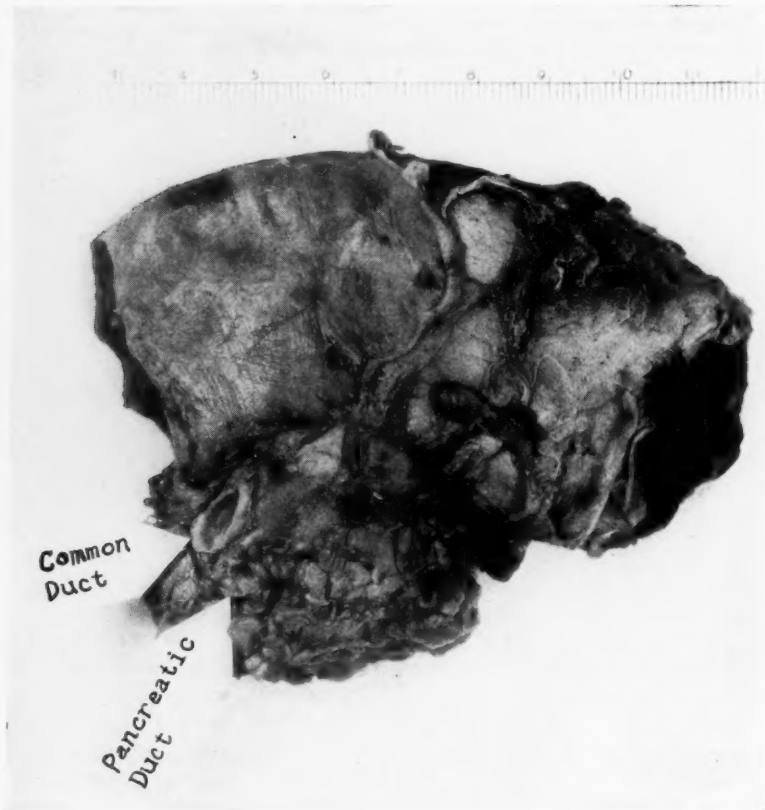


FIG. 6.—Case III.—Posterior view of gross specimen consisting of duodenum and head of pancreas. Note dilated common and pancreatic ducts.

by jaundice, clay colored stools and dark urine. No pain since the first attack, which lasted one-half hour. Had previously had belching and distress after meals for 20 years. Loss of 18 pounds in three months.

*Physical Examination*.—A well developed colored man of 49 with a greenish tinge to his skin, and markedly icteric sclerae. Heart not enlarged, sounds regular, good quality. Lungs negative. Abdomen—liver edge is felt 6 cm. below costal margin. No signs of fluid. Examination otherwise negative. Temperature, 98.8°; pulse, 70; respirations, 20; blood pressure, 110/70.

*Laboratory Data*.—Hemoglobin, 76; red blood cells, 4,000,000; white blood cells, 7,400; polymorphonuclears, 66. Bleeding and clotting time, normal. Stool negative for



## CARCINOMA OF AMPULLA OF VATER

bile or blood. Serum bilirubin, 10.9. Wassermann—Cholesterol 3+, Alcohol, negative. Repeat Wassermann negative. Duodenal drainage—no bile obtained. Sedimentation rate 65, defibrinated 3, Takata slightly positive. Urine—bile positive.

Patient was discharged to decide on operation and returned two days later, January 24, 1935. Blood N.P.N.—20 Gm./L Serum bilirubin, 8.0 mg. per 100 cc. Roentgenogram of abdomen negative for stones.

*First Operation.*—January 25, 1935. First stage procedure for excision of duodenum and head of pancreas for carcinoma, consisting of gastro-enterostomy, cholecystgastrostomy, and ligation of the common duct below the cystic duct.

*Pathology.*—The findings in this patient promised unusually well for removal of what was considered to be a carcinoma of the papilla. The common duct obstruction was thought to be due to a small tumor mass about two centimeter in diameter situated in the region of the papilla. The common duct was markedly dilated, as was the gallbladder, but no stones were made out in either the gallbladder or common duct. There was an anomaly of the cystic duct which complicated the procedure somewhat, inasmuch as ligation of the common duct had to be carried out at a lower level than was desired because of the long cystic duct emptying into the common duct in the retroduodenal portion on the common duct. There were no enlarged nodes made out. No masses palpable in the liver. The liver was somewhat enlarged due to the common duct obstruction.

*Procedure.*—A reversed L-shaped incision was made in the right upper quadrant. Procedure as described. Silk technic. Course.—Little or no reaction following operation. Jaundice subsided. In four days had bile in stools and bile disappeared from urine a few days later. Serum bilirubin dropped slowly from eight milligrams before operation, and was still showing a trace on the twenty-fifth day. On the thirteenth day resection was done.

*Second Operation.*—February 7, 1935. Resection of duodenum and head of pancreas. Spinal anesthesia. Procedure.—Transverse incision above umbilicus. Adhesions were rather numerous, but duodenum could be mobilized and turned forward to the left. After this the lower end of the common duct was isolated with some difficulty and the duodenum was resected, the point of section being just distal to the pylorus above and proximal to the superior mesenteric vessels below. A wedge-shaped portion of the head of the pancreas was then removed, so that the specimen included the ampulla of Vater and the tumor. The duodenal ends were then inverted and the pancreatic stump closed with interrupted silk sutures.

*Course.*—Little reaction following second operation, but a serous discharge on the third day which on analysis showed pancreatic ferment. Blood amylase was 40 on the day of operation and 44 the following day—remained below 20 after this. Fasting blood sugar rose to 1.28 on the second day, and was under 100 after this. The discharge persisted in moderate amounts up to the eighth day, following which there was a small amount, apparently from the subcutaneous tissues at the site of the drain. Up on the twelfth. Discharged on eighteenth day with a small draining wound.

*Pathologic Report.*—Gross.—The specimen consists of a portion of the head of the pancreas, the duodenum, and the common bile duct and pancreatic duct, removed in a second stage operation for carcinoma of the papilla of Vater. In the fixed stage the duodenum measures nine centimeters long on its convex surface. The serosal coat is rough and somewhat shrunken, owing to having been torn by retractors. A mass can be palpated through the wall in the region of the papilla.

On opening the duodenum there is a small ulceration about 6 Mm. in diameter, which is irregular in shape and occupies the site of the opening of the papilla into the lumen of the duodenum. No opening, however, can be made out. The tissue beneath this is indurated and fixed to the wall.

The pancreatic tissue removed with the specimen measures 5 by 3 by 2.5 cm. and is attached to the concave surface of the duodenum in its upper portion. The common bile duct and the pancreatic duct can be seen coursing through the upper portion of the pan-

creatic tissue. The common bile duct, where it has been cut through, measures about 7 Mm. in diameter. The pancreatic duct measures 4 Mm. in diameter. A probe inserted into each of these in the fresh specimen passed to the papilla but not through any opening into the duodenum.

On section the two ducts are seen to course side by side towards the region of the papilla, and just below the papilla there is a firm, grayish-white, ovoid mass measuring 1.3 by .8 by 1 cm. which appears to have not only involved the papilla of Vater but has completely destroyed the lower end of the pancreatic duct and bulges in toward the lumen of the lower end of the common duct, invading the wall of both of these and blocking the opening completely.

Situated on the upper anterior inner wall of the duodenum, 6 Mm. from the upper line of resection, is a small papillary shaped nodule measuring 3 Mm. in diameter and

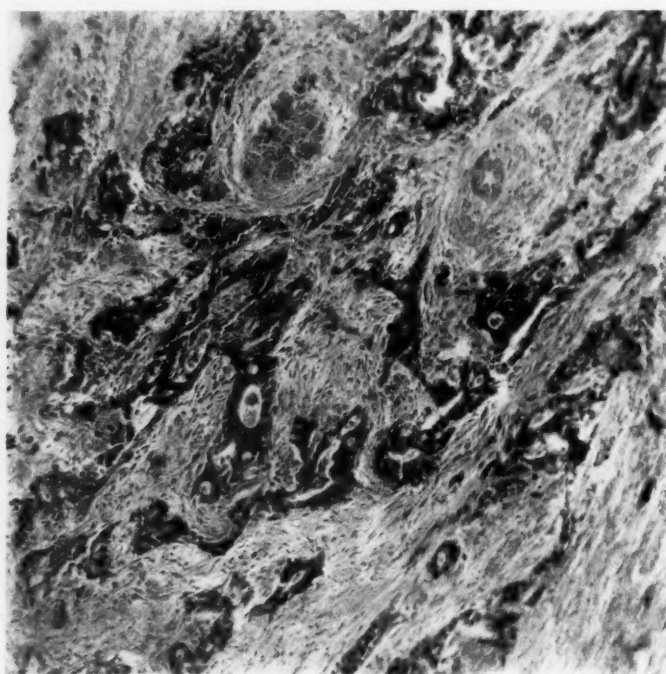


FIG. 7.—Higher magnification of tumor from Case III, showing the carcinoma cells.

raised above the mucosal surface 1 Mm. This has two tiny openings or depressions within it. A section of this, however, reveals no duct-like structure under it or any connection with the pancreas which might suggest an accessory pancreatic duct.

On the posterior aspect of the duodenum and pancreas six lymph nodes were found, the largest measuring 8 by 5 by 4 Mm. All of these are soft except one which is situated immediately behind the tumor and firmly adherent to it, and is harder and filled with white tissue, and appears to have been involved by direct extension.

*Microscopic.*—A section has been taken longitudinally through the common duct, pancreatic duct, ampulla, and includes a portion of the pancreas. The common duct histologically appears patent, but is obstructed by the tumor mass which involves the entire lower end of the pancreatic duct and adjacent duodenum where it joins the lower aspect of the papilla of Vater. The tumor is a carcinoma made up of irregular, infiltrating glands and strands of small hyperchromatic epithelial cells which show mitoses on an average of 1 per high power field. These cells secrete large amounts of mucin in

## CARCINOMA OF AMPULLA OF VATER

some areas. Both sides of the lower end of the common duct at the ampulla are involved with the tumor tissue. The surface of the tumor at the ampulla is ulcerated and covered with inflammatory cell debris. The tumor does not extend upwards along either the common or pancreatic ducts. No direct extension can be seen through the duodenal wall into the pancreas.

A section through the small nodule at the upper line of resection of the duodenum shows this to be composed of an adenomatous mass of duodenal mucous glands which are perfectly regular in shape and only show a small amount of epithelial hyperplasia. A few deep crypts can be seen presenting on the lumen side, but no real ducts, which might be considered an accessory pancreatic duct.

Sections of all the lymph nodes show one to be definitely involved with a small metastasis. In addition, the firm white node adherent to the deep surface of the tumor shows carcinoma bordering it, but not actually invading, and extending completely through the adjacent issue. This would indicate that some tumor was left behind at the time of operation. The prognosis, owing to this last finding and owing to the metastasis, must be considered unfavorable. *Diagnosis.*—Carcinoma of ampulla of Vater with metastases to retroperitoneal lymph nodes.

*Second Admission,* March 25, 1935. Discharged April 13, 1935. The patient was well until March 25, 1935, about two months after operation, when he was seized with sudden severe epigastric pain which became steadily worse, and was accompanied by a bile stained vomiting. He was readmitted, at which time his temperature was normal. He had upper abdominal spasm and tenderness. White blood cells, 21,900; polymorphonuclears, 92 per cent; blood amylase, 72. Examination of the stools at this admission for fat absorption showed that he was utilizing 88 to 90 per cent of his fat intake. Blood calcium and phosphorus were normal.

*Third Operation.*—March 25, 1935. Exploratory celiotomy. The patient was explored under spinal anesthesia. In the region of the right upper quadrant there was a small pocket containing 20 to 30 cc. of yellowish fluid, the culture of which showed *B. coli* and non-hemolytic streptococcus. The tissues in this area were very edematous, and although no fat necrosis was present, it was felt that the patient had a mild acute pancreatitis. This area was drained, and the patient made an uneventful recovery.

*Course.*—The fistula drained what apparently was pancreatic juice (since it contained all the ferments), for about two weeks, and then closed. The patient was discharged in good condition April 13, and has remained well since that time.

### DISCUSSION

The operation proposed in this paper has certain advantages over those previously described.

(1) It carries out the principle of cancer surgery in excising, *en bloc*, tissues wide of the growth. In this particular condition this principle is applicable because extension of the growth from the papilla has been found to be either into the neighboring pancreas or up along the lining of the common duct.

(2) The hazard of surgery is reduced by a two stage procedure, insuring the relief of jaundice and improvement of nutrition by the first stage and excising the lesion radically when the risk to the patient is minimized. In our first case of radical removal, duodenal obstruction appeared later because of the drag set up against the superior mesenteric vessels. We therefore have inserted a gastro-enterostomy as part of the first stage.

There are certain theoretical objections to the removal of a large part of the duodenum and permanent obstruction of the pancreatic ducts.

Hershey and Soskin<sup>9</sup> and Berg and Zucker<sup>10</sup> noted fatty degeneration of the liver in animals with ligation of pancreatic ducts, and with total pancreatectomy.

Sweet<sup>3</sup> described a peculiar translucence and atrophy of the spleen and thyroid in the dog after obstruction of the external pancreatic secretion. In our patient coming to autopsy, because of a cholangitis eight months after the radical operation, none of the above changes was noted in liver, thyroid, or spleen.

The objection to this procedure on the basis of disturbed fat digestion due to lack of pancreatic ferments was considered, but much to our surprise the utilization of fat in both of our patients several weeks after the radical procedure was remarkably good, 85 to 90 per cent of the fat intake was absorbed, as shown by stool examinations. Furthermore, both patients gained and maintained their normal weight three and seven months after operation.

That there may be a compensatory secretion of fat splitting ferment in the upper intestine is suggested, but requires further experimental study before any positive statement can be made.

A certain amount of atrophy of the acinar tissue of the pancreas has already taken place in these patients before they come to operation, due to the obstruction of the pancreatic duct by the neoplasm. This probably accounts for the small amount of leakage of pancreatic juice after this operation.

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DISCUSSION.—DR. DAMON A. B. PFEIFFER (Philadelphia, Pa.).—I have little in the way of personal experience to add. It is very fitting, however, that this Society should recognize the importance of this contribution because it is quite apparent that a new and brilliant chapter is being added to the surgery of this condition.

None of us is too young to be aware of the timidity with which surgeons in general have approached any radical interference on the pancreas. It is true that in 1884 Billroth, that great pioneer and innovator, reported complete removal of the pancreas with success from an immediate operative standpoint, but his lead found few followers. A few years later, Mikulicz, then possessing the greatest authority in the surgical world, pointed out the enormous increase in mortality entailed in operations or removal of the stomach when the pancreas itself was in any way included.

Gradually, however, as a result of isolated experiences, it became apparent

that some surgery, at least, could be done upon the pancreas, that limited resections could be made safely, and Finney, in this country, was one of the first to draw our attention to the feasibility of such procedures. He reported before this Association in 1910 a case of resection of the body of the pancreas for benign tumor. The two divided ends were reunited and the result was entirely satisfactory.

Following this, sporadic cases of limited resection for various indications appeared in the literature and surgeons in general began to lose their fear of operative procedures on this organ.

The dangers of interfering with the head, however, deterred almost everybody from attempting radical intervention in that location. It is true Desjardins, in 1897, devised a very ingenious operation that was satisfactory mechanically for the removal of the head of the pancreas. It involved three separate anastomoses, one to restore continuity of the gastro-intestinal tract, one to reintroduce the bile into the intestine, and another to preserve the external secretion of the pancreas, which was at that time thought to be essential to life.

Naturally, such procedures are hardly feasible in cases as met clinically and Finney, in his paper, sounded a very pessimistic note as to the possibility of ever being able to carry it out. However, this new contribution shows that by proper combination of procedures it is entirely feasible to resect the ampulla, which means resection of the head of the pancreas. By a little extension of our imagination now we can see ourselves removing early carcinomata from the head of the pancreas if we are fortunate enough to get and recognize them in time.

The difficulties of recognition of this condition in the early operable stage are great. The success of this procedure depends apparently upon recognition of two things, first of all, the importance of separating the operation into two stages. That important military maxim of "divide and conquer" has been applied successfully now in many situations and here apparently it gets a new application. It necessitates, however, an absolute diagram before embarking upon the plan.

The second important thing to appreciate is that the external secretion of the pancreas is not essential to digestion and preservation of life. We might have deduced this from experiment and proved it to be true. As a matter of fact, I think pathologists were aware of it before clinicians. I recall in my course of pathology at Johns Hopkins, that Opie had somewhere obtained a specimen of a pancreas at the autopsy table, which consisted of nothing more than islands of Langerhans imbedded in fibrous tissue. All the glandular elements of external secretion had disappeared, but the patient had lived for a considerable time. It remained for later work to show it is possible to avail ourselves of this fact clinically.

The difficulty of diagnosis to which I refer may be illustrated by a case which I had only recently, a man whose history and condition were in every way typical of stone in the common duct. At operation he had a small thick gallbladder containing stones and a hugely dilated common duct. I opened his common duct and found no stone, no sand, no indication of any foreign material in the duct.

With the greatest difficulty, I finally succeeded in introducing a probe into the duodenum, dilated the opening and felt I was dealing with stricture of the papilla of Vater, put in a T tube, and stopped. He made a good recovery and bile at first passed into his intestine. After removal of the tube, however, his internal damage persisted and bile finally ceased to flow into his duodenum. It was apparent he had complete obstruction in his common duct. I felt pos-



sibly I had overlooked a stone. I again explored his common duct, which at that time was big enough so I could introduce my finger into the distal portion of the duct, and came to a dead end. I could feel it perfectly well. There was no suggestion of tumor formation. There was no stone, but simply a dead end at the intestinal extremity. I made a choledochoduodenostomy and the patient promptly got well and has remained so.

I had never met with a similar case, but Ellsworth Eliot referred me to a report by Herferth some years before in which he had found at autopsy what he called prolapse and intussusception of the common duct. It was an entirely new entity to me, but it seems to fit this case. In this condition the end of the common duct had bulged into the duodenum, reversed itself and mechanically completed the obstruction of the strictured papilla.

My admiration for the surgeons who carried out this very successful operation is not only for the ingenious, brilliant operative procedure which they have devised, but also for their boldness in making this a positive diagnosis in this early stage.

DR. EVARTS A. GRAHAM (St. Louis, Mo.).—I wish to compliment very highly Doctors Whipple, Parsons and Mullins for their brilliant work. It is another example of the step-like progress which has to be made before a final goal is reached.

I wish to discuss for a moment the question of the importance of the pancreatic juice in digestion.

There was no evidence so far as I know that in a rapidly growing young subject it is possible to carry on a normal development without much pancreatic juice until suddenly an emergency which confronted me approximately two years ago seems to have established the fact. I operated on a baby that was less than two years of age because of intractible hypoglycemia which retarded it greatly, both mentally and physically. We hoped to find a pancreatic adenoma at operation, but the pancreas looked perfectly normal. In view of the previous partial resections of the pancreas which had been made by Judd and Finney among others, in the absence of finding a definite adenoma, I decided that it might be worth while to make as nearly a total resection of the pancreas in this youngster as was possible, without jeopardizing the common bile duct.

The procedure was carried out successfully; the case was reported in September, 1934. One month ago I had a letter from this little girl's mother, which stated that the child had developed in a perfect manner physically, and that there seemed to have been no difficulty, whatever, with her digestion. At operation I performed a subtotal removal of the pancreas, leaving only a little strip of tissue along the common bile duct to protect it.

The operation, therefore, described by Doctors Whipple, Parsons, and Mullins, I feel is based on what seems to me to be thoroughly sound physiologic evidence of the fact that, so far as the secretions of the pancreas are concerned, it is a perfectly safe procedure to carry this operation out, especially in view of the fact that if a rapidly growing child can apparently get along perfectly well without the external secretion of the pancreas, certainly an adult ought to be able to do so. There is another point, however, which deserves some comment. What assurance have we that a patient can go along indefinitely with a cholecystogastrostomy or a cholecystoduodenostomy without developing a severe infection of the liver? The evidence with which I am familiar indicates that almost invariably the patient succumbs from multiple abscesses in the liver if the anastomosis remains open. It might be possible, however, to devise an anastomosis which would prevent the ascend-

ing infection, in a manner perhaps analogous to the Coffey operation of transplantation of a ureter.

DR. WILLIAM PARSONS (New York).—Dr. Eliason is about to publish an article in which he discusses the question of cholecystogastrostomy. In our patient who died, we feel beyond a doubt his septicemia was the same type that so many cholecystogastrostomies will show later on.

Doctor Eliason quotes Bernard in an article showing that about 25 per cent of a rather large series of cholecystogastrostomies, performed for a variety of conditions, were followed by cholangitis. In this particular case, although we tried to make a large opening, the gallbladder was so enormous I think we did not estimate the degree to which it was going to contract later on. At postmortem the cholecystogastrostomy opening admitted only a probe and it was quite obvious that this was the cause of the bad result.

## A TECHNIC FOR HEPATICODUODENOSTOMY

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Not so often as formerly but occasionally, surgeons are compelled to reconstruct the common duct. We now possess sufficient clinical data to show that whenever it is feasible anastomosis of the hepatic duct to the duodenum should be the operation of choice. Our personal experience on which this paper is based consists of 14 cases in which the bile passages have been reconstructed. In eight of the 14 cases we have been able to perform hepaticoduodenostomy. As a result of this experience there has developed a fairly definite and orderly method of operation. We do not claim that hepaticoduodenostomy can be, or should be, performed in every case of stricture of

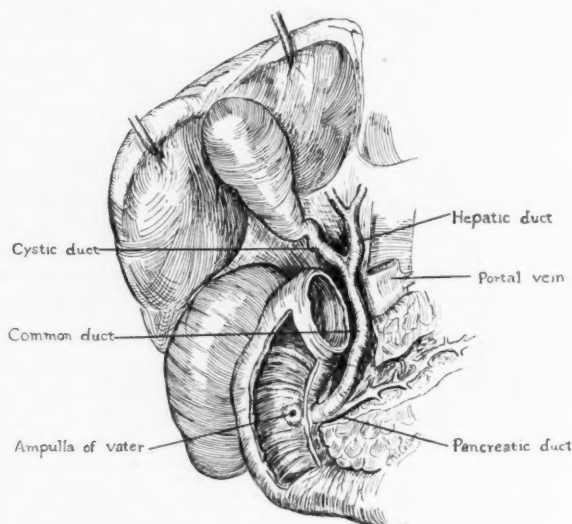


Fig. 1

Anatomy of field of operation

the common duct. Manifestly this would not be true. Much of the time, especially when the injury to the common duct occurs in the operation of cholecystectomy as shown in Fig. 2, the operation herein described is not only feasible but is the operation of choice.

All of the so called autoplasmic reconstructions of the ductus choledochus fail because of contraction of the transplanted tissue. It mattered little whether the tissue transplanted was fascia, blood vessel, or what not, invariably there was contraction of the transplant which sooner or later defeated the effort at repair. Lahey has devised a very ingenious method of turning into the duodenum the fistulous tract. This operation, while limited in its field of

# HEPATICODUODENOSTOMY

usefulness, has a quite definite place, we think. Here as elsewhere and, particularly in this type of surgery, individual resource and discriminating judg-

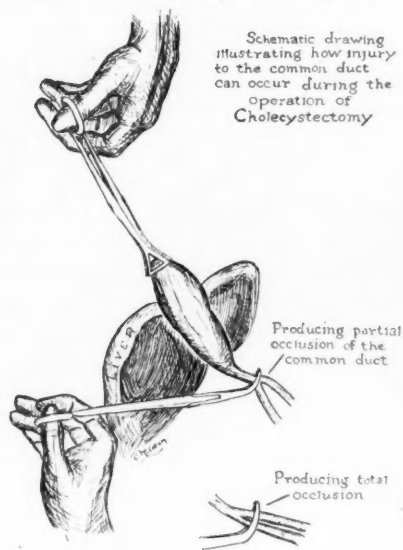


Fig 2

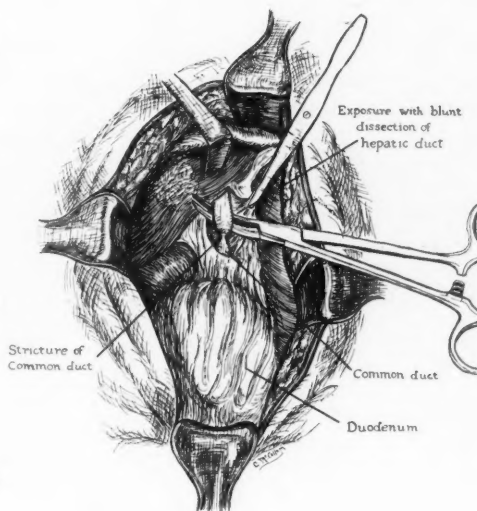


Fig 3

Method of blunt dissection

ment which holds the various methods within their normal natural fields of limitation is the sine qua non. There is no substitute, either, for what Uncle Remus refers to as "a little hard sense."

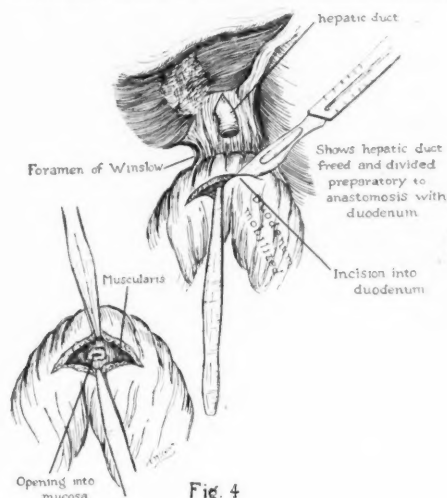


Fig. 4

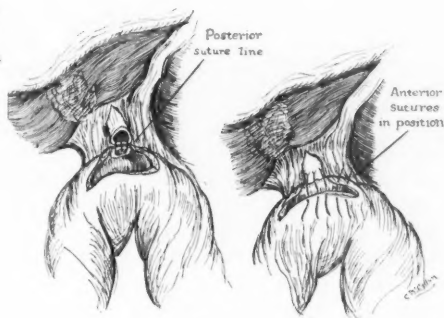


Fig. 5

Shows placing of posterior and anterior sutures

The following case description will serve as a definite illustration of the method presented.

*Illustrative Case.*—A white man 73 years of age presented himself complaining of pain in the abdomen, and jaundice. He had been operated upon and his gallbladder re-

moved four years before. Following this operation he was well for only a very short time. His skin remained slightly yellowish, but it was not until two years ago that he began having pain in the gallbladder region. Then followed a gradually deepening jaundice. In the past three months the pain has been quite severe, there has been more or less constant nausea and occasional vomiting, and a progressive loss in weight.

The general physical examination showed a moderate jaundice, a few coarse râles at the bases of the lungs, a blood pressure of 180/80 and a large hernia through the scar of the high right rectus incision of the cholecystectomy. There were no palpable masses in the abdomen and the other findings were normal for a man of his age. Except for a clotting time of six and one-half minutes, the laboratory blood findings were not abnormal. The urine showed a faint trace of albumin, and occasional hyaline or granular cast and, a very few red blood and pus cells.

A high right rectus incision was made under spinal anesthesia and a mass of adhesions freed from the site of the former gallbladder operation. The dissection of the common duct was extremely difficult but it was finally exposed for about 1½ cm. along its

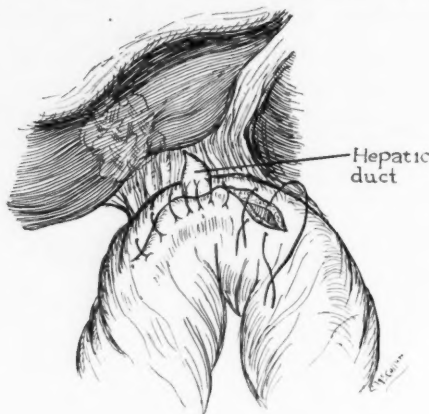


Fig. 6

#### Operation completed

course. It was opened just below a constriction in the duct, just at the junction of the common and hepatic ducts. The hepatic duct above this stricture was nearly 2 cm. in diameter. A transverse section was done, the distal end ligated, and the proximal end implanted in the side of the duodenum with a double layer of catgut sutures. Several small stones were removed which had pocketed in the area above the stricture. A small cigaret drain was inserted and the wound closed in layers.

An uneventful convalescence followed. The temperature never went over 100° F., and the jaundice had almost entirely disappeared by the tenth day. There was, however, a very slight yellowish tinge to the skin upon dismissal three weeks after operation though the sclerae were entirely normal in appearance.

A subsequent report on this patient's condition five years after operation showed complete symptomatic cure.

In this particular case both the postoperative hernia and the stricture of the common duct were of my own making.

The value of this paper, if any, hinges on the illustrations. With particular emphasis we direct attention to Fig. 3, which shows the method of dissecting the hepatic duct or the common duct, from the immediately adjacent



## HEPATICODUODENOSTOMY

portal vein and hepatic artery. With a sharp knife we carefully incise the connective tissue sheath over the duct and complete the blunt dissection with a pair of sharp pointed artery forceps.

In almost every case the hepatic duct will be markedly dilated proximal to the stricture. This greatly facilitates its exposure once you definitely find out where you are. In practically all of the eight cases of hepaticoduodenostomy the duct was demonstrated as clearly as the illustration shows.

The further steps in the operation are best observed in the illustrations.

At other times and in other places we have reported our cases of reconstruction of the ductus choledochus particularly before the Surgical Section of the American Medical Association in June, 1918, and again in the southern number of *Surgical Clinics of North America*, August, 1930. This paper, as its title implies, is concerned only with the problem of hepaticoduodenostomy.

## THE OPERATIVE REPAIR OF SLIDING HERNIA OF THE SIGMOID

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SLIDING herniae of the ascending, descending and sigmoid colon have been recognized for years. The absence of definite physical findings differentiating a sliding hernia from the common indirect oblique variety renders the pre-operative diagnosis practically impossible. The infrequency of this type of hernia leads one into pitfalls, unless it be recognized early during the operative procedure for an inguinal hernia. It must be realized that in a true sliding hernia, not only is the bowel carried down the inguinal canal, but also the all important associated nutrient vessels. Attempts to isolate the sac, as in the operative procedure for an indirect oblique inguinal hernia, are impossible. To misinterpret the difficulties encountered as being produced by adhesions about the sac has on more than one occasion led to a devitalization of the blood supply of the sigmoid colon, and in one case seen by a colleague in consultation, gangrene of the bowel followed such an accident. A similar disaster was reported in the *British Journal of Surgery*, and the loop forming part of the hernia was amputated before the real anatomic arrangement was recognized. Fortunately, an anastomosis in this instance resulted in recovery.

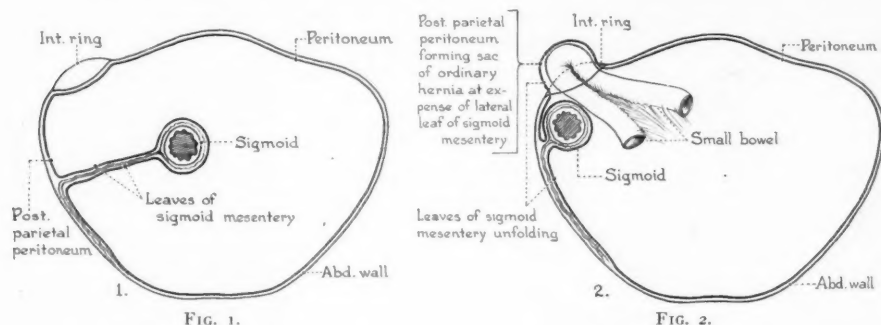
The lack of unanimity of opinion regarding the proper operative procedures which should be used in the repair of sliding hernia of the sigmoid is justification for a recital of our experience in four cases in the last few years. Previous to this group we had operated on seven cases by various procedures, with a high percentage of recurrences. This led us to a survey of the suggestions which had been put forth to efficiently deal with this technical problem.<sup>4, 5, 6, 7, 8</sup> The most valuable contribution, by Moschowitz,<sup>1</sup> dealing with the pathologic anatomy of sliding hernia, clarified for us the basic requirements of an operative procedure which would effectively repair such a hernia. In his thesis he divides the genesis of such herniae into either a pulling or a pushing mechanism, the former producing a large hernia and the latter a smaller hernia. His reiteration that only a viscus partially covered by peritoneum can take part in a sliding hernia precluded the likelihood of the free sigmoid loop being associated with such a hernia. He stated that, while he could conceive of the sigmoid being the involved portion of the colon, he had not encountered such a condition.

The four cases which we are reporting all occurred with the free sigmoid loop being the portion of the colon which formed the apex of the hernia. All were large herniae, and it appeared to us that this was the result of a pushing mechanism, which shoved the posterior peritoneum lateral to the

# SLIDING HERNIA OF SIGMOID

sigmoid through the internal ring, and as this pushing mechanism increased, it unfolded the peritoneal leaves forming the mesentery of the sigmoid (Figs. 1 and 3). This placed the sigmoid loop at the apex of the hernia; the vessels lay behind it, and the peritoneal cavity became continuous with the bulge on the anterior wall of the mass of the hernia. This production of a large hernia by a pushing mechanism is at variance with the hypothesis which Moschowitz originally put forward.

The diagnosis of a sliding hernia may be suspected if we have a history of a hernia of long standing increasing in size, when a truss which formerly was efficient can no longer be worn because of the pain and irritation attendant upon its use, the hernia finally becoming irreducible. In two of our cases this was the definite sequence of events, and in only one of the four cases could a truss be worn without undue pain, but it proved to be ineffective in controlling the hernia. In none of these cases was the hernia strangulated, nor could we elicit any history which might be interpreted as even a partial



strangulation during their development. The ineffectual attempts to reduce the irreducible herniae were accompanied by an unusual degree of pain.

White<sup>2</sup> has also found these three points in cases of sliding hernia which he has encountered, namely: they seldom strangulate; attempts at reduction are ineffectual and exceedingly painful, and in his group a truss which formerly was worn in comfort had to be discarded because of pain.

While the above clinical findings may be present in an ordinary indirect inguinal hernia, if one bears in mind the sequence of the symptoms and physical findings during the development of the hernia, one may at least suspect the possibility of a sliding hernia, and thus be forewarned before undertaking the operation. To be alert to the possibility of the hernia being of the sliding variety renders its recognition relatively easy, and the operator is thus able to avoid disaster, and save himself many anxious moments while the true nature of the anatomic disturbance is determined.

With the inguinal canal open one is immediately impressed with the amount of fat which is present about the sac. The thickness of the sac, and the inability to return the contents to the peritoneal cavity, are striking. There is visible a thin layer of peritoneum in front of the sac, but the sharp crescentic border of the fundus is conspicuous by its absence. As one attempts to lift

up the sac, it is impossible to follow the continuity of the anterior peritoneal layer with a similar layer posteriorly. In the posterior area there is encountered undue vascularity (Fig. 3), which immediately should lead one to suspect this unusual type of hernia. By opening the peritoneum visible on the anterior wall of the hernia, one finds the colon occupying the apex of the sac, and the continuity of the peritoneum is over the colon and continued up along the posterior wall of the sac. We thus realize that only a small portion of the circumference of the colon is in contact with this peritoneal covering. Our experience with seven previous cases in attempting to return this bowel to the peritoneal cavity and repair the wall has been neither happy nor satisfactory. Believing that the true pathologic anatomy of this type of hernia was an unfolding of the peritoneal leaves of the sigmoid mesentery, we immediately opened the peritoneal cavity by a paramedial incision, as originally suggested by Moschowitz. On withdrawing the sigmoid into the peritoneal cavity through this new incision, the opening which had been made in the

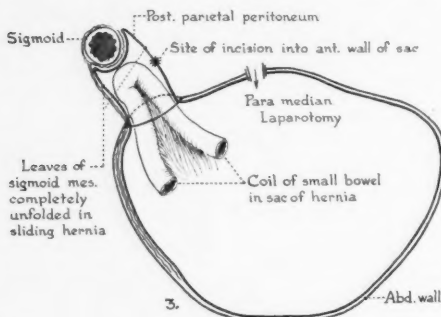


FIG. 3.

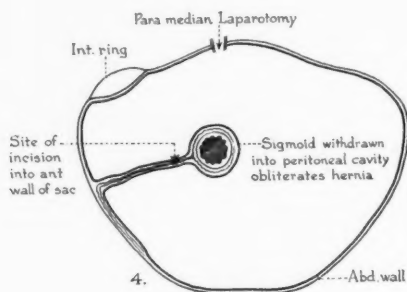


FIG. 4.

anterior peritoneal layer of the hernial sac now comes to be simply a linear slit in the peritoneum forming the lateral leaf of the sigmoid mesentery (Fig. 4). This defect is closed by a continuous suture. When the hernial wound is again inspected, we find that all evidence of hernia has disappeared; there is no redundant peritoneal sac, and we are confronted with the problem of repairing the inguinal canal, as in the ordinary operation for indirect oblique inguinal hernia.

The work of Seelig and Chouke<sup>3</sup> directed to the relative merits of union between fascia and fascia and muscle and fascia, so favorably impressed us that for many years we adopted their suggestion of uniting fascia to fascia by suturing the medial margin of the free edge of the opened external oblique aponeurosis to Poupart's ligament and overlapping the lateral leaf of the external oblique on top of this mesial layer, behind the cord, which was transplanted external to the aponeurosis. A recent survey of our late results disappointed us by showing a high incidence of recurrences at the site of the new internal ring. We have now returned to the classic Bassini type of repair, using a strip of fascia from the external oblique, as suggested by McArthur, or the living sutures of fascia or fascial patch removed from the

fascia lata of the thigh, as suggested by Gallie. The Gallie operation is reserved for all recurrent cases, or those in which the defect at the internal ring is large, and the muscular structures atrophic.

It may be argued that to add a laparotomy to a supposedly simple hernia operation is not only unnecessary but unjustifiable. However, we submit that a sliding hernia of the sigmoid is not a simple hernia, nor is its repair a simple surgical procedure. An operation for sliding hernia carries with it not only the potentialities of immediate disaster, but an incidence of recurrence much higher than that following the operative procedure carried out for indirect oblique inguinal herniae. The delightful convalescence of our patients has not impressed us that the laparotomy is a great additional hazard. It does not prolong the bed rest nor increase the economic time loss. Indeed, the addition of a laparotomy wound is a minor procedure, compared to that required for the repair of a recurrent sliding hernia.

In conclusion, to be on the alert for the possibility of a sliding hernia of the sigmoid during operations for supposedly simple indirect oblique inguinal hernia, renders the recognition of this condition relatively simple.

The addition of a laparotomy wound in the repair of this type of hernia removes the hazard of injury to the nutrient vessels and renders a repair of the peritoneal unfolding simple and efficient. When this has been carried out, the repair of the inguinal canal may then be carried out unhampered by whatever technic has found favor with the individual surgeon.

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- <sup>4</sup> Bevan, Arthur Dean: *ANNALS OF SURGERY*, p. 754, October, 1930.
- <sup>5</sup> Watson, Leigh F.: Sliding Hernia. *Internat. Clinics*, vol. 4, pp. 155-163, Dec., 1925.
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**DISCUSSION.**—CARL G. BURDICK, M.D. (New York).—In addition to the diagnostic points which Doctor Graham has outlined, a roentgenogram following a bismuth enema will reveal the presence of the sigmoid or colon in the hernial sac. At the Hospital for Ruptured and Crippled we have operated on 18 sliding herniae of the sigmoid in the last 5,000 cases, a rate of about one in every 250 herniae.

Early opening of the sac simplifies the operative procedure. The incision should be made with a sharp scalpel in the anterior and lateral parts of the sac. Careful sponging will enable the operator to recognize the musculature of the bowel or any unusual bleeding due to invasion of the retroperitoneal space, before serious damage takes place. Reduction of the bowel can be accomplished by the method of Moschowitz, as suggested by Doctor Graham, or by forming a new mesentery, as suggested many years ago by Hotchkiss.



We prefer the latter due to its simplicity and the shortening of the operating-time, as most of these types occur in patients advanced in years.

High ligation of the sac does not play the same part in the radical cure as in a simple indirect inguinal hernia, consequently a more thorough attempt must be made to repair the abdominal defect. The emergence of the cord through the layers of the abdominal wall, irrespective of where it lies, leaves a defect; and for the past six years we have completely divided and resected a portion of the cord to insure a more complete closure. We have completely divided the cord in 200 operations for different types of hernia including 14 of the sliding variety. The recurrence rate for the latter group is 7.7 per cent. In this series of 200 operations, four testicles sloughed, a good many atrophied, but 42 were recorded as normal in size, having been traced for from one to five years. In addition to the division of the cord we are inclined to use a

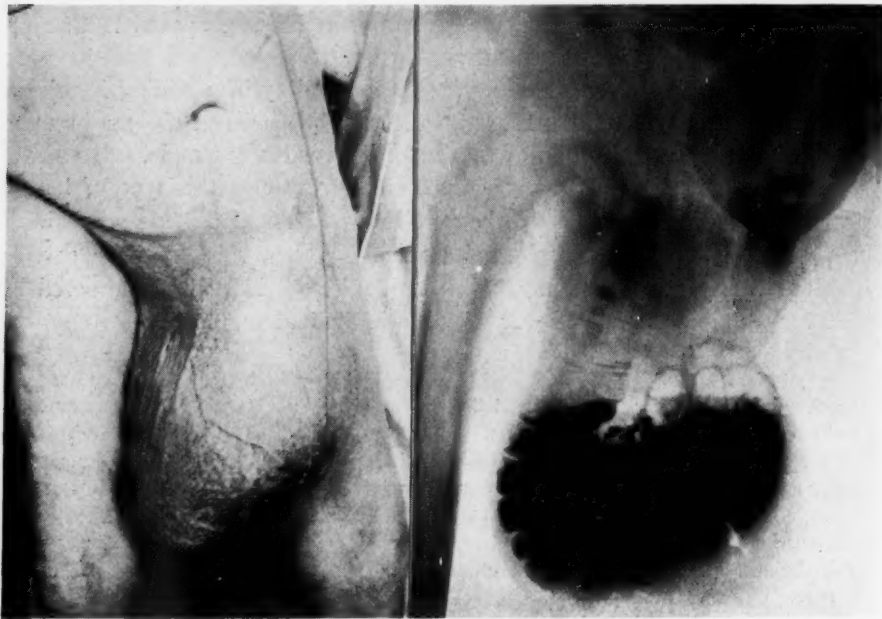


FIG. 5 shows a large scrotal hernia.

FIG. 6 shows the sigmoid in the hernial sac.

fascial suture repair. Our results with the McArthur method have not been so satisfactory as with the Gallie strips removed from the thigh.

Doctor Burdick supplemented his prepared discussion, with the following remarks and two illustrations:

As Doctor Graham stated, they are usually very large and we rather suspected that this might be of the sliding variety. Consequently we had a roentgenogram taken following a barium enema.

I think it is always a good plan to have a roentgenogram if we suspect a sliding hernia.

DR. A. D. BEVAN (Chicago, Ill.)—Four or five years ago I made a report of some work we had done on sliding hernia and the outstanding observations were: First of all, most of our cases have been on the right side. We came to the conclusion that one of the important factors that prevented a permanent

## SLIDING HERNIA OF SIGMOID

cure was the enormous size of the neck of the sac. The other factor was the difficulty of reducing the contents of the sliding hernia into the abdominal cavity; this was true whether it was of the cecum or the sigmoid.

After operating on a number of these cases, we devised the appended method, which has been most satisfactory.

A study of the anatomy of these cases shows that the blood supply of the colon on both the right and left sides comes entirely from the inner side, and that the outer layer of the mesentery is avascular. I want to emphasize the fact that in dividing the peritoneum so that the colon can be put back into the abdominal cavity we should be careful to limit the division to the outer layer, the avascular layer of the mesentery.

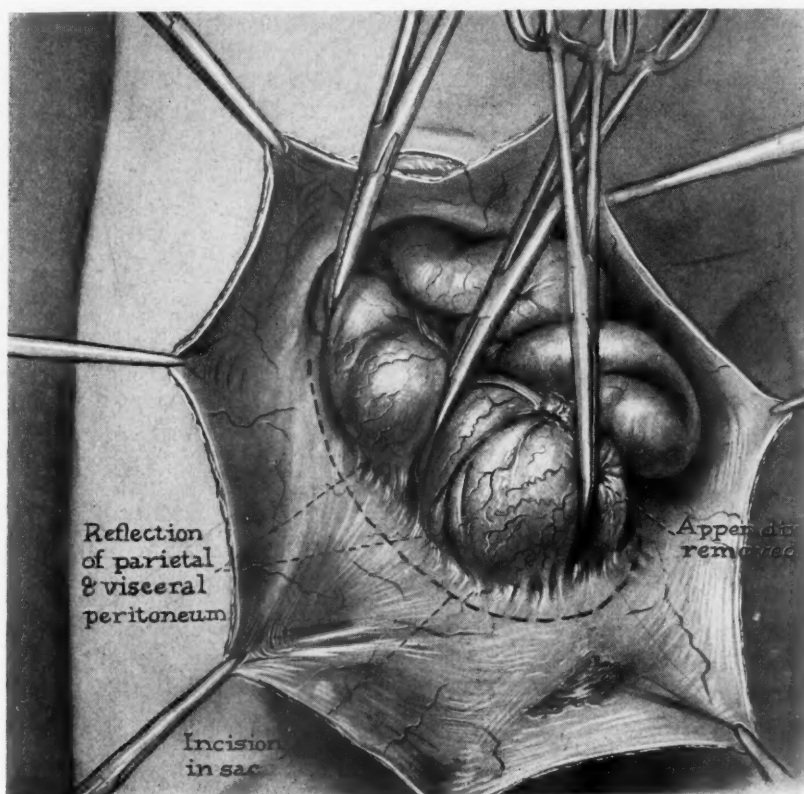


FIG. 7.—Large sliding hernia.

Let us visualize a large sliding hernia on the right side. You will see, in the first place, the enormous size of the mouth of the sac, which prevents closure by means of a ligature being of any value. In the second place, visualize the fact that in this sac we have the cecum and appendix and ascending colon and ileum. After opening the sac widely the division of the peritoneum made to mobilize the colon must be made in the avascular outer layer (Fig. 7).

After you have made the incision in the peritoneum, you then lift up the cecum and unite the peritoneal flaps with fine catgut so that you cover the raw surface of the colon completely (Fig. 8).

After you have done this, you can then return into the abdominal cavity,

the cecum and the ileum. Then the second problem is to take care of the enormous sac.

In order to accomplish this we adopted a method which we use constantly in all cases of direct hernia, and that is the method of invagination of the sac, because we have found that in the ordinary direct hernia you have also a very large neck to the sac to deal with and that there is a great tendency to recurrence after operation if the sac is simply ligated and cut off. We found in our work that in the direct hernia, by adopting this method of invagination, we have eliminated recurrence in almost all of our cases.

Doctor Graham said to me that it was difficult for him to understand the technic. It is rather difficult unless you actually see the operation done.

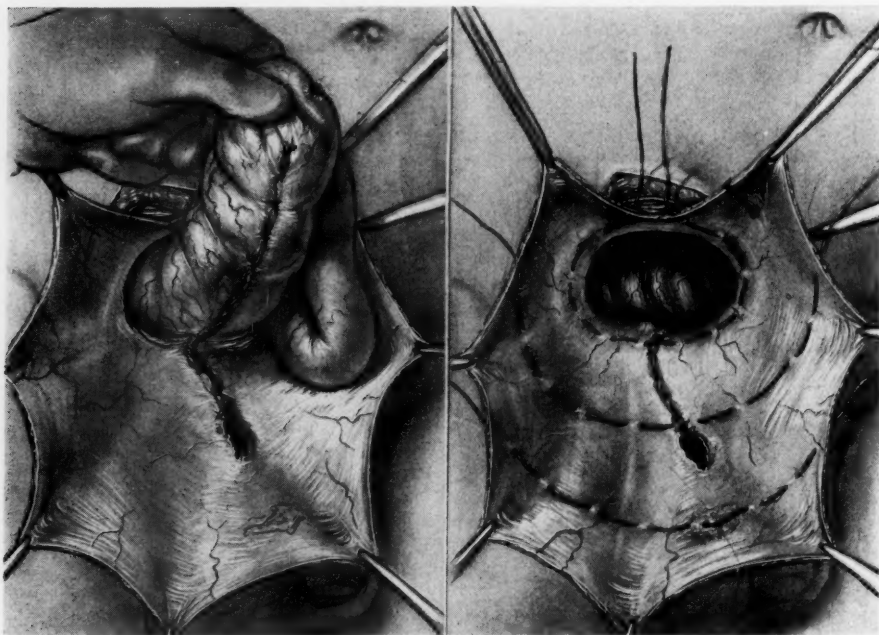


FIG. 8.—Peritonization completed.

FIG. 9.—The mobilized bowel has been returned to the abdominal cavity. Three purse string sutures have been placed preparatory to reduction of the large sac.

After we have mobilized and peritonealized the contents of a sliding hernia and returned them into the abdominal cavity, the next step is the invagination of the sac into the abdominal cavity. With the sac open we put in three catgut purse string sutures. The upper suture starts on the outer side of the vertical incision in the sac, goes through the peritoneum, and comes out on the inner side of the vertical incision, the second and third sutures in the same way (Fig. 9).

This is rather an excessively large sac. Where the sac is very large, we remove the excess portion of it, but retain a great deal of the peritoneum because we want it as a pad inside of the abdominal cavity. The vertical incision in the sac is then closed with fine catgut. You see, you now have three purse string sutures. You invaginate the first part of the sac and tie the suture. You then invaginate another portion of the sac and tie the second suture, then the third suture and you have the condition as it is represented here (Fig. 10, A, B, C, D). Inside the peritoneal cavity, you have this large

## SLIDING HERNIA OF SIGMOID

piece of peritoneum folded as a pad of peritoneum at the internal ring. We have found, as in direct hernia, that this has given us more insurance against recurrence than any other method.

It is rather confusing to one who has not done this operation before, but after all, it is quite simple. I very strongly advocate this method of handling the sac in both sliding hernia and in direct inguinal hernia. You know, there is a great tendency to recurrence in both and it really is due to the fact that we used this invagination method in direct hernia in a great many cases and had

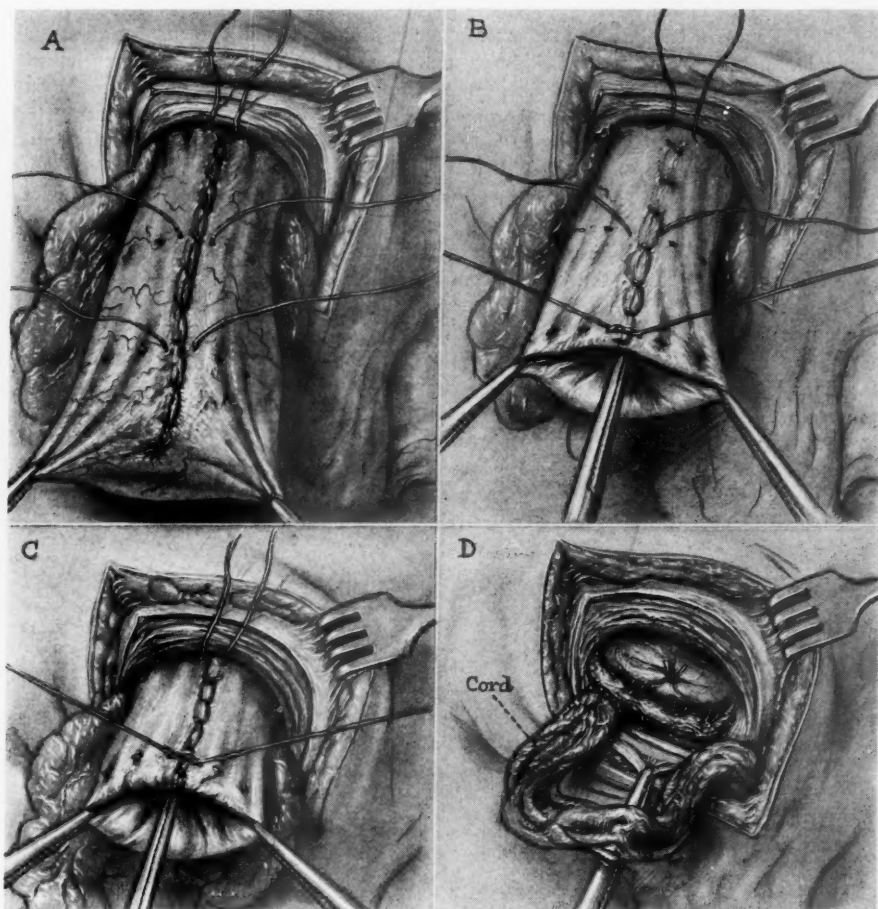


FIG. 10.—The successive steps of invagination of the sac. A shows the edges of the sac brought together with a running suture, making a complete closure. B and C show the first two steps of invagination. In D the final purse string has been tied and the sac completely turned into the peritoneal cavity.

been very successful with it, that we applied the same conception to sliding hernia.

DR. EMMET RIXFORD (San Francisco, Calif.).—I have had occasion to operate on a number of sliding herniae. Off hand it is my impression that there is little difference in frequency between the right and left side, though I believe that I have had more sliding herniae of the sigmoid than of the cecum. Most so called colossal herniae are of this nature.

CASE REPORT

Mr. K., aged 49, was a barkeeper; he therefore did not have to get about very much. His right inguinal hernia kept enlarging until he was obliged to support it with a great leather sling hung from a harness about his shoulders. It was so large that he could not bring his knees together within a foot or more. He said "it finally got to be something of a drag on him." When he came to us in 1915 the sac reached well below his knees. Sac and contents weighed approximately 50 pounds. Urination was through a long tunnel with about a foot of balanitis and the skin of the scrotum was the seat of a dermatitis giving considerable risk from sepsis.

Operation showed the sac to contain about a gallon of fluid, practically all the abdominal contents except the liver, kidneys and stomach; and actually the entire intestine from the pylorus to the sigmoid was in the sac. I think Doctor Bevan would have been interested in attempting to pucker up the sac. The intestine had been out so long that it had practically lost the right of habitation. We took away the entire omentum and then doubling the man up by flexing his thighs, in order to overcome the lumbar lordosis, we secured considerably more room in the abdomen and finally succeeded in feeding the intestines back into it. We then cut away a considerable area of skin and a large excess of sac. After all that is all that need be done in the management of the sac and is best done after replacement of the hernial contents. Care of course must be exercised not to cut across either the intestine or the mesenteric vessels, suturing the edges of the peritoneum at what might be called the neck of the sac as in any other laparotomy.

Of course in this case there was a great deal of adventitious fibrous tissue; various fasciae were greatly hypertrophied. We used these tissues to close the wound by a process of imbrication, of four or five different layers. For some hours we were worried by cyanosis doubtless due to pressure on the diaphragm, but this gradually disappeared. After a somewhat stormy convalescence due to infection in which the testicle sloughed, the man recovered. Fifteen years afterwards he returned with an enormous varicose ulcer of his leg. The hernia had not recurred.



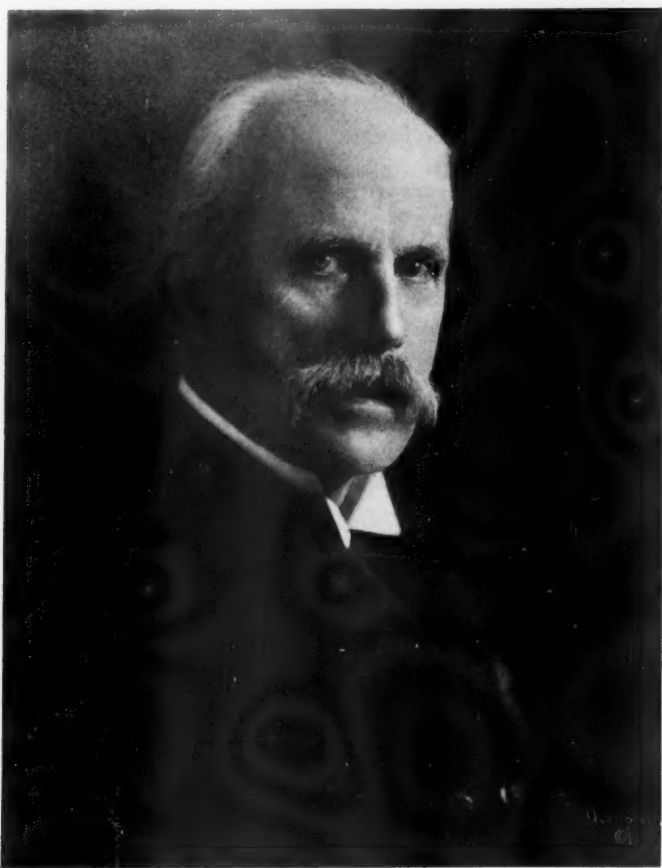
## MEMOIR

LEWIS STEPHEN PILCHER

1845-1934

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SOMETIMES there appears among his fellows, whose lives and work are for the most part fragmentary, episodic, incomplete, a man whose whole long life responds to one clear call. Such was Lewis Stephen Pilcher. Dying in



LEWIS STEPHEN PILCHER, M.D., LL.D.

his ninetieth year, he left behind him an unbroken record of faithful service in surgical practice, in surgical letters and in the impress of his character upon his associates and his time.

He was born in 1845, the second son of Elijah Holmes Pilcher, a Methodist preacher in Michigan. Elijah Pilcher was himself no ordinary man. An

Evangelist-Administrator, as his son has said, "of strong and athletic build, a silent, thoughtful and studious man." A pioneer Evangelist with a horse, saddle-bags, and his beloved Greek testament, he traveled over the whole southern portion of Michigan "interested not only in the affairs of his own denomination but also in everything that involved the welfare of the nascent State."

In his work as a founder of churches and an administrator of ecclesiastical affairs, he often found himself confronted by questions of law. So he registered himself as a student of law, and at odd times, and as an incident to his ministerial labors, pursued his studies so well that he was admitted to the Bar. Later on when he found himself stationed at Ann Arbor he was able by midnight and early morning study to graduate as Doctor of Medicine. This was in 1859. Lewis S. Pilcher has said "My own thoughts of a medical career date from this period. My father took me with him into the dissecting room and the chemical laboratory and gave me my first insight into the mysteries of the human body and the wonders of chemistry. But a few years later I was myself working as enthusiastically in both departments as my father had done before me. It was as natural that I should grow up into medicine as it was that a fledgling should fly when it was pushed out of the nest by the mother bird."

There were four other children and the salary paid by the most important Methodist church in Michigan in 1852, when Elijah H. Pilcher was its pastor, was \$300. Throughout his career he never received a salary of \$1000 a year—and yet his children were fed, clothed, and educated. "The chief agent in the successful accomplishment of such a result was the wife and mother, who, by her prudence, industry, frugality, and personal labors so cherished and amplified the meager support received from the church as to practically, yearly, repeat the old miracle of the Widow's Cruse of Oil." A sturdy, healthy, happy family brought up to help themselves and each other with an example always before them of studious, earnest effort. Here in his own home he received most of his early education. His father taught him Latin and Greek, his mother saw to his grammar, algebra and natural philosophy. One year in high school at Ann Arbor and he was ready for the University of Michigan, in the fall of 1858, at the age of 13. "I enjoy the distinction," he said, "of having been the youngest matriculant and the youngest graduate in the history of the institution."

Four years in college, living at home, a fact he partly deplored, but which was probably better for him than he knew during those turbulent war time adolescent years. Expelled from the University for a boyish prank, reinstated evidently by family influence, graduated and beginning the study of medicine and then swept into the war. A hospital steward subject to the vagaries of military orders, the first years away from home, no father, no books, half house surgeon, half superintendent, a good commanding officer and a cold douche of reality. Duty in a Missouri border plantation big house converted into an hospital with the vicissitudes of the last futile guerrilla

raids of a dying confederacy; mustered out, more medical studies soon completed, doctor in medicine. Why not go back to the Service? Try the Navy. Too young, not yet 21, insufficient clinical experience! Back to Michigan and medical practice. A try out in Flint. No patients. Try Schwartz Creek. General country practice, an opportunity to help the exchequer by teaching school. Moderate success. An opportunity to take a house surgeonship at Detroit. Grasped. Taken. Able chiefs—Farrand and Andrews, Jenks and McGraw: "at the flame of their enthusiasm and ambition, I lighted my own torch."

A year in New York at Bellevue and now better fortune—a commission in the Navy as Assistant Surgeon, ordered for duty at the Naval Hospital in Brooklyn. Four years in the Navy, some shore duty, some at sea, some experience with yellow fever, and romance and marriage with a Brooklyn girl; a baby coming and orders to go to sea. It must be done! Resignation from the service and the establishment of a practice in Brooklyn. Once more frugality and patient effort in that rapidly growing conglomerate small town suburb of the great city. A foothold in general practice, recognition of ability and of character by important citizens and by the leaders of the profession. Friendship with Skene and Fowler and a realization of the possibility the town of that time offered of *otium dignitate*, unobtainable in the city beyond the river, kept him at rest.

An appointment as teacher of anatomy in Long Island College of Medicine fortified his resolve. He labored for a surgical appointment but found his somewhat uncompromising personality in the way, and then a break! An invitation to assist in organizing the new Methodist Hospital, a well endowed institution; to carry on in surgery and in medicine the recent advanced ideas of the great new age. A period of foreign study and 20 splendid years of professional accomplishment and of inspiration to younger men.

Two stout sons, raised in the profession and then when his long service most deserved reward, his hospital betrayed him. He resigned, converted his ~~home~~ into a private hospital and with his boys, carried on, developed his and their high ideals of surgery as it should be and for ten short years won the appreciation and acclaim of his colleagues and the city. Broken by the sudden death of the elder son, while the younger was at the Mexican border with the army, the hospital was transferred to other hands. During those years however he had shown that a doctor's workshop could be maintained in the highest standard of scientific efficiency, without assistance or interference by meddling laymen.

His later years were enriched by his activities in the G.A.R., mustered into U. S. Grant Post in 1907. In five years he was elected Commander, in five years more Commander of the Department and at the end of a third five year period, Commander-in-Chief of the entire Grand Army. It gave him great satisfaction.

He was a sedulous collector of old masters in medicine and in 1918 published a quarto volume of 200 pages entitled A List of Books by Some of

the Old Masters of Medicine and Surgery Together with Books on the History of Medicine and on Medical Biography, which were in his own possession.

His own contributions to the literature of direct surgical effort were many and fill pages of the *Index Medicus*. The earliest were those in connection with the procedure of tracheotomy in diphtheritic croup, now fortunately an obsolete necessity. In the late '70's and '80's, however, this was not the case and his studies of the anatomy, surgery, etiology and epidemiology of that now forgotten subject might still well serve for models of studies of conditions with which we struggle—awaiting the advance of knowledge and their disposition in the limbo of oblivion.

He contributed to the literature of Injuries to the Wrist and of the Treatment of Wounds. His papers on the Surgery of Cancer of the Breast; of the Surgery of the Colon; of Prostatic Hypertrophy and Hemorrhoids and many others, reflect the scholarly consideration of his own cases in the light of the recorded experience of others. He contributed often to the literature of hospital organization and to the History of Medicine and in his Autobiography—*A Surgical Pilgrim's Progress*—left a record of his origins, the sources of his ideals, his inspirations and his indefatigable industry.

The most valuable portion of his works was, however, anonymous. How many famous papers owe their acclaim to his unselfish editing, or to his preliminary suggestion? How many juvenile asininites owe their non-existence to his strict and honest rejection. Faithful are the wounds of a friend. The Editor of the *ANNALS OF SURGERY* was faithful.

A few years after coming to Brooklyn, and no doubt influenced by his associations as a teacher of anatomy, he and others formed a club for the promotion of the practical study of anatomy and surgery, by the maintenance of proper rooms for the pursuit of such studies, by the formation of a museum, by the accumulation of a library, by lectures and demonstrations and by stated meetings for the discussion of subjects pertaining to that special field. This was the Brooklyn Anatomical and Surgical Society, of which Pilcher was the first President and George R. Fowler the Secretary. Its transactions for the first year form Volume I of the *Annals of the Anatomical and Surgical Society*. Arrangements for publication were made with Putnam's Sons as a monthly journal. At the end of a year its name was changed to that of *Annals of Anatomy and Surgery* and under the joint editorship of Pilcher and Fowler it carried on until January, 1884, when, its joint editors and owners having planned a trip to Europe for study, publication was suspended. On Pilcher's return he was visited by James H. Chambers of St. Louis, the publisher of the *Weekly Medical Review*, and plans were discussed for the founding of a "strictly surgical journal of a high class." Apparently Pilcher approached the suggestion with eagerness. "Now here was a flat proposition from a hard-headed acute business man who practically proposed to fully assume all the responsibility, labors and expenses of publishing such a

periodical, while absolute control of the scientific contents of the journal and censorship of the advertising pages were guaranteed to me."

The first number of the *ANNALS OF SURGERY* was published in January, 1885. In January, 1892, the imprint of the University of Pennsylvania Press of Philadelphia was substituted for that of James H. Chambers of St. Louis. In the Spring of 1897 the *ANNALS* was acquired by the J. B. Lippincott Company of Philadelphia who have continued to publish it since that time. With the collaboration of American and British surgeons, too many to mention in detail and by name, the reporting of the transactions of the American Surgical Association, the New York Surgical Society and the Philadelphia Academy of Surgery, its careful and faithful editorial policy has been its fame. He states, "Nearly every line of all these volumes has passed under my own eye, has been corrected, often extensively edited and always prepared for the compositor's final proofs, read and the completed making up into monthly numbers decided upon by myself, for such is the duty of an editor."

When the *ANNALS OF SURGERY* began in January, 1885, there was no other purely surgical journal in the English tongue—there are many now of many variations. The *ANNALS* has kept to its well defined course—a Monthly Review of Surgical Science and Practice, until a few short months before his death, under one guiding hand. A great achievement! A monument more lasting than bronze.

JOHN E. JENNINGS, M.D.



## BOOK REVIEW

MODERN OPERATIVE SURGERY: Edited by G. GREY TURNER, M.S., F.R.C.S. (Eng.), Vols. I and II, 2nd edit. Baltimore: William Wood & Co., 1934.

ONLY one who has visited Grey Turner's Clinic in New Castle-upon-Tyne can fully appreciate the two volumes under the above title. That Clinic, dominated by one man, indefatigable, working in all the major fields of surgery, with apparently few associates, is epitomized in these two volumes. For although there are many authors taking part in the work, Grey Turner is the outstanding figure and gives the work an individual character, even though he has attempted faithfully to carry out the spirit and purpose of H. W. Carson, the editor of the first edition.

The work as a whole is based upon Carson's conception of the first edition. One wonders at some of the arrangement and order of the subjects. As in all systems where the several topics and chapters are written by different individuals there is a considerable variation in style, method and virtue of the material discussed. Some chapters are much more comprehensive and up-to-date than others. A criticism that can be made of other English text-books is the preponderance of English statistics and the lack of adequate personal follow up data. More American authorities are quoted than continental. One notes a very definite tendency to quote figures and reports from literature that we would consider quite out-of-date. Quite justly, because of the large number of cases and his personal knowledge of the surgeons working there, the Mayo Clinic is most frequently quoted.

Taking some of the chapters in the order given, the reviewer has noted his impressions; thus R. C. Elmslie writes the chapter on orthopedic surgery; this includes general orthopedics, amputations and operations on tendons. There is very little, if any, discussion of simple fractures. Operations on bones are discussed by E. W. H. Groves, and those on joints by P. J. Verrall. In the discussion of tuberculous joints and bones one is surprised to find so little consideration of Hibbs' fundamental principles of immobilization by fusion and his remarkable results are not quoted. The Boston School is also given little appreciation. In the procedures for chronic suppurative osteomyelitis, the Orr vaselin pack method so favorably received in the United States, is not mentioned.

The chapter on thoracic surgery is written by J. E. H. Roberts. Of the more recent advances made in this field, Shenstone and Janes' operation for lobectomy is rightly emphasized. Nothing however is said about total pneu-

## BOOK REVIEW

mectomy for carcinoma. Platts' chapter on surgery of the nerves is remarkable for the very complete report on the results of operations for the repair of nerve injuries. Drummonds' chapter on vascular surgery, revised by Grey Turner is comprehensive and shows the lessons taught by the Great War. Sampson Handley in his original and sound fashion discusses the principles of operative treatment of tumors in general and of the breast in particular. These chapters are thorough, sound and constructive.

The latter half of the first volume, given over to abdominal surgery, is largely written by Grey Turner and reveals his wide experience, his rare judgment and special interests. The chapter on abdominal injuries is noteworthy, as are the chapters on the appendix, the intestinal and biliary tracts. Walton contributes the chapter on gastric operations. It is surprising that with his wide experience he has not had better results in gastric resection for cancer. He also writes the chapter on ptosis and intestinal stasis. It is worth noting that he discredits the operation of colectomy and the theories upon which it is based. Grey Turner gives an unusually comprehensive discussion of cancer of the colon and rectum, and includes a personal communication from Miles on his one stage abdomino-perineal removal of the rectum. The chapter on surgery of appendicitis and peritonitis is excellent and shows Grey Turner's experience and surgical judgment.

In the second volume are included the surgery of the specialties of the eye, nose and throat, neurologic fields, urology and gynecology. These chapters are written by able men in these fields. One is surprised not to find in the section on gynecology, by Giles, any discussion of radium therapy for cancer of the cervix. In the section on urologic surgery by Sir John Thompson-Walker and John Everidge there are remarkably interesting tables on the immediate and late results following the major urologic procedures. Especially to be commended is the fair presentation of the relative merits of suprapubic and perineal prostatectomy. One is surprised that continuous suction is not advocated postoperatively in cases of suprapubic cystostomy.

Tanner in his chapter on surgery of the neck gives much space to the radical removal of tuberculous nodes but none to the reduction of the disease by eliminating bovine tuberculosis. He does not mention the use of roentgen ray therapy.

Walton writes the chapter on the thyroid. There is little, if any, originality in his technic and a great lack of follow up data on his own cases. He gives only half a page to the discussion of hyperparathyroidism. The discussion of the surgery of the sympathetic nervous system by Goeffrey Jefferson is unusually well presented, up-to-date and adequate.

As a whole these two volumes represent British surgery at its best. Because of Grey Turner's travel and broad interests in Continental and American Clinics this system is much more cosmopolitan than any other English text on surgery. The illustrations are for the most part well chosen and well exe-

cuted. The diction and style, as in all British text-books, is superior. The one glaring fault noted is the lack of personal follow up data by the individual authors. This is only partly compensated for by the statistics collected from the literature.

ALLEN O. WHIPPLE, M.D.

#### EDITORIAL ADDRESS

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